EFFECTS OF BREAKFAST OMISSION ON SLEEP QUALITY, COGNITION AND GLUCOSE HOMEOSTASIS AMONG YOUNG ADULTS.

Dissertation submitted to

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI-600 032.

In partial fulfillment for the degree of

Doctor of Medicine in Physiology (Branch V)

M.D (PHYSIOLOGY)

MAY-2018

DEPARTMENT OF PHYSIOLOGY

CHENNAI MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE

IRUNGALUR, TRICHY-621 105.

CERTIFICATE

This Dissertation titled "**EFFECTS OF BREAKFAST OMISSION ON SLEEP QUALITY, COGNITION AND GLUCOSE HOMEOSTASIS AMONG YOUNG ADULTS**" is submitted to the Tamil Nadu Dr. M.G.R Medical University, Chennai, in partial fulfillment of regulations for the award of M.D. Degree in Physiology in the examinations to be held during May 2018.

This Dissertation is a record of fresh work done by the candidate, **DR.SV.AJANTHA.**, during the course of the study (2015-2018).

This work was carried out by the candidate herself under my supervision.

DR.NACHAL ANNAMALAI M.D.,

Guide & HOD,

Department of Physiology,

Chennai Medical College Hospital&

Research centre,

Trichy-621 105.

DR. SUKUMARAN ANNAMALAI M.D.,

DEAN

Chennai Medical College Hospital& Research centre,

Trichy-621 105.

CHENNAI MEDICAL COLLEGE HOSPITAL & RESEARCH CENTRE

IRUNGALUR, TRICHY – 621 105.
E.Mail : researchcmchrc@gmail.com, Phone: 0431-3058863,3058817

INSTITUTIONAL ETHICS COMMITTEE CERTIFICATE.

Ref.No: CMCH&RC/IEC –No:128 /26.11.2015

Sub: Approval of research work related to / project of faculty- IEC – Issued-Reg.

The research proposal submitted by **Dr. S.V.Ajantha, Ist yr PG.** Dept. of Physiology, Chennai Medical College was discussed and analyzed by the Institutional Ethics Committee of the CMCH&RC. The committee approved the research project subject to existing rules and regulations.

Title of the Research work/Project:
Effects of breakfast omission on sleep quality , cognition and glucose homeostasis in adults.

a. She should abide to the Ethical aspects of the institutional Ethics Committee.

b. She should not deviate from the proposal submitted

c. She has to inform IEC if any deviation / modification whenever considered.

d. She should carry out the project within the stipulated period and if extension needed, She has to inform IEC

e .She should get appropriately designed informed consent subjects/patients of the study group.

f. She should not claim any monetary support from IEC

g. She should cooperate with the members of IEC while they visit / monitor the activities

h. She should entitle to make use of this approval letter for obtaining financial support from funding agencies by submitting his application through the Dean, CMCH&RC.

i. She is informed that she should submit the summary of the report to the IEC after completion of her project

k. **IEC Comments: Approved, Consent from study subjects to be obtained and kept in her custody for verification by IEC any time.**

Member Secretary
[DR.S.D. Nalinakumari]

TO
Dr. S.V.Ajantha, Ist yr PG. Dept. of Physiology, CMCH&RC, Trichy
Copy to office

INSTITUTIONAL ETHICS COMMITTEE
Chennai Medical College Hospital & Research Centre
Irungalur, Trichy-621 105
Date.....

ACKNOWLEDGEMENT

I am deeply grateful to the **Prof.Dr.SUKUMARAN ANNAMALAI M.D.,** Dean, Chennai Medical College & Research centre for making it possible to carry out my study in College and hospital grounds.

It is a genuine pleasure to express my deep sense of thanks and gratitude to my mentor and guide **Prof. Dr.NACHAL ANNAMALAI M.D.,** H.O.D, Dept of Physiology, Chennai Medical College Hospital & Research centre. Her dedication, keen interest and an overwhelming attitude to help her students had been solely and mainly responsible for completing my work. Her timely advice, meticulous scrutiny, scholarly advice and scientific approach have helped me to a very great extent to accomplish this task.

I owe a deep sense of gratitude to **Dr.M.MUHIL M.D.,** Associate Professor, Department of Physiology, Chennai Medical College Hospital & Research centre for her constant support at every stage of my research. Her prompt inspirations, timely suggestions with enthusiasm and dynamism have enabled me to complete my thesis.

My deepest gratitude to **Dr.S.KRISHNA KUMAR M.D.,** & **Dr.M.RAJA JEYAKUMAR M.D.,** Assistant Professors, Department of Physiology for their continuous optimism concerning my work and valuable suggestions.

It is my privilege to thank my colleagues **DR.TAMILSUDAR** & **DR.R.PREETHA** for their constant encouragement throughout my research period.

I express my heartfelt thanks to our **tutors & Non-teaching Staffs** for their enthusiasm, encouragement, kind help and co-operation throughout my study period.

I am extremely thankful to family & friends for providing me necessary moral support, constant encouragement during my research pursuit.

I thank **Dr.C.GURU DUTTA PAWAR M.D.,** Vice Principal, Chennai Medical College for his support in completing this study.

I am in debt as it's my duty to thank to my heart's content my subjects who have undergone the inconvenience and discomfort for the completion of my study.

DECLARATION

I, **Dr.SV.AJANTHA** hereby solemnly declare that the dissertation entitled **"EFFECTS OF BREAKFAST OMISSION ON SLEEP QUALITY, COGNITION AND GLUCOSE HOMEOSTASIS AMONG YOUNG ADULTS"** was done by me at Chennai Medical College Hospital And Research Centre, Irungalur, Trichy, under the supervision and guidance of **Dr.NACHAL ANNAMALAI.M.D.(PHY),** Professor and Head of the Department of Physiology, Chennai Medical College Hospital And Research Centre, Irungalur, Trichy.

This dissertation is submitted to Tamil Nadu Dr. M.G.R Medical University, towards partial fulfillment required for the award of M.D. Degree (Branch-V) in Physiology.

I have not submitted this dissertation on any previous occasion to any university for the award of any degree.

Place: Trichy

Date:

Dr.SV.AJANTHA

CERTIFICATE

This is to certify that this dissertation work titled **"EFFECTS OF BREAKFAST OMISSION ON SLEEP QUALITY, COGNITION AND GLUCOSE HOMEOSTASIS AMONG YOUNG ADULTS"** of the candidate **Dr.SV.AJANTHA** with registration number **201515551** for the award of M.D. Degree in the branch of Physiology (Branch-V). I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 1 percentage of plagiarism in the dissertation.

DR.NACHAL ANNAMALAI M.D.,

Guide & HOD,

Department of Physiology,

Chennai Medical College Hospital&

Research centre,

Trichy-621 105.

ORGINALITY CHECK

URKUND

Urkund Analysis Result

Analysed Document: plag check.docx (D31136354)
Submitted: 10/9/2017 10:02:00 AM
Submitted By: aju.pretty@gmail.com
Significance: 1 %

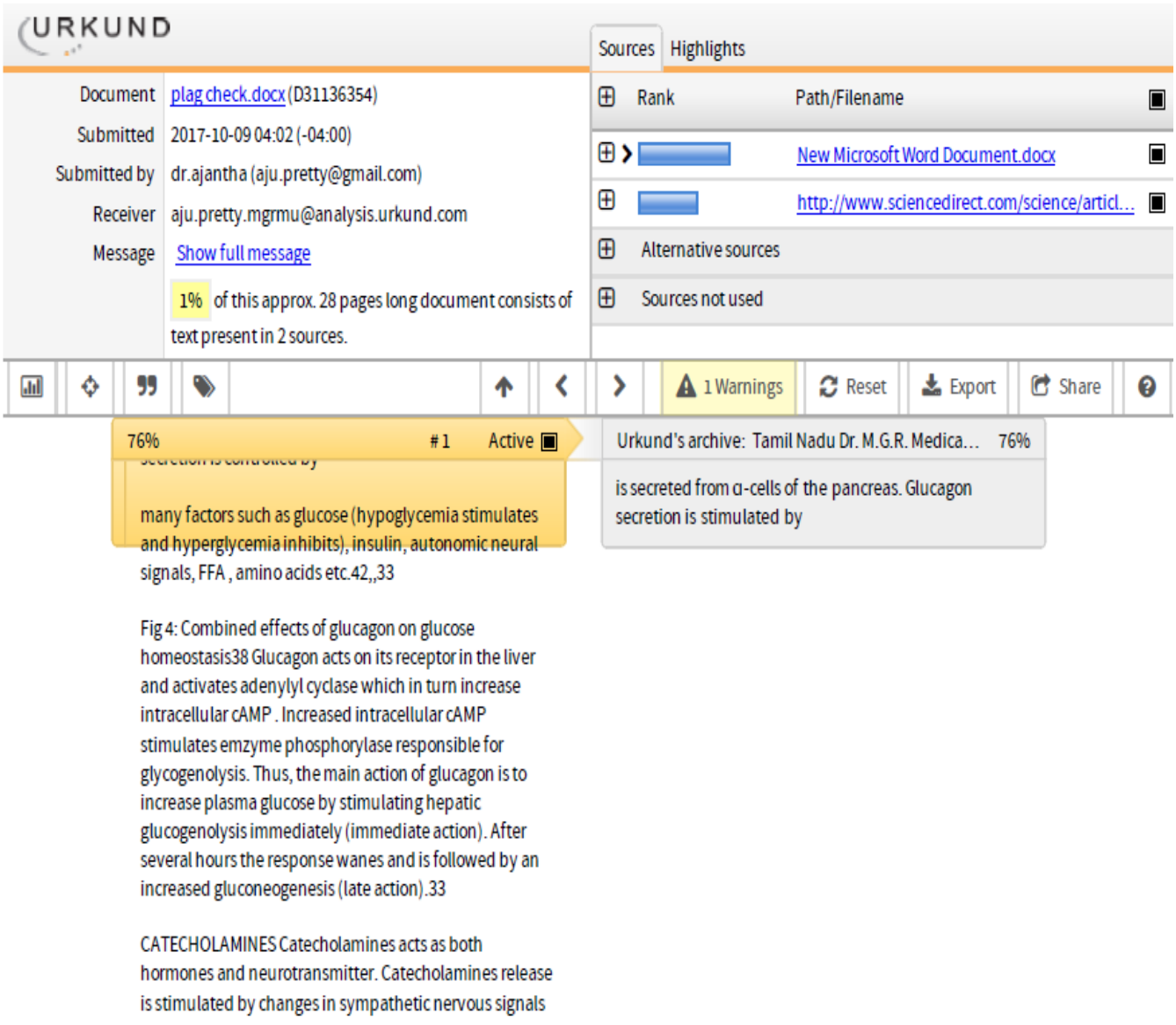
Sources included in the report:

New Microsoft Word Document.docx (D30392163)
http://www.sciencedirect.com/science/article/pii/S0165178115302183

Instances where selected sources appear:

3

ORGINALITY CHECK



CONTENTS

LIST OF ABBREVIATIONS

- BMI — Body mass index
- WC — Waist circumference
- HC — Hip circumference
- W:H ratio — Waist : Hip ratio
- PSQI — Pittsburgh sleep quality index
- WJ III — Woodcock Johnson's battery of tests for cognitive abilities-III
- CHC — Cattell-Horn-Caroll theory
- GLP-1 — Glucagon like peptide-1
- GIP — Gastric inhibitory peptide
- FBG — Fasting Blood Glucose
- OGTT — Oral Glucose tolerance Test
- Gc — Comprehension Knowledge
- Gs — Processing speed
- Gsm — Short-term memory
- Glr — Long term retrieval
- Gf — Fluid reasoning
- Ga — Auditory Processing
- Gvs — Visual-spatial thinking

- Gq Quantitative Knowledge
- SWS Slow Wave Sleep
- REM Rapid Eye Movement
- NREM Non-Rapid Eye Movement
- EEG Electro-Encephalogram

LIST OF FIGURES

LIST OF TABLES

LIST OF CHARTS

INTRODUCTION

Breakfast is defined as "the meal that is eaten first in the morning within 2 hours of waking and eaten before or at the start of daily activities (e.g. errands, travel, work) but not later than 10AM in the morning and that provide an energy level between 20 and 35% of total daily energy needs." proposed by Timlin et al. [1]

Breakfast omission is defined as skipping breakfast at least three days a week.[2] Breakfast consumption habit is associated with adequate macro and micronutrient intake and maintenance of ideal BMI, hence it is recommended as part of a healthy diet.[3,4] Even though the common impression is that regular breakfast consumption is a healthy habit, frequency of breakfast consumption habit has declined in children, adolescents, and adults in the past several decades.[5,6]

There are only few studies showing breakfast intake being linked with health.[7] Breakfast skipping have been shown to increase 24h blood glucose which indirectly indicates it causes changes in glucose homeostasis.[7,8] Frequent and daily breakfast consuming persons were found to have decreased risk of developing abdominal obesity, metabolic syndrome, hypertension, and type 2 diabetes in US. There is no conclusive literature on the effects of breakfast skipping habit on glucose homeostasis in Indian population.

Regular intake of breakfast showed enhanced cognitive abilities and good academic performance in children, which encouraged public health bodies to conduct school health breakfast programs.[9] Breakfast consumption was found to have positive effects on memory function in the previous studies. But effects of breakfast consumption on other cognitive abilities such as attention, problem solving skill etc were not studied.[10]

Eating breakfast (with protein – tryptophan content) maintain good quality of sleep, morning type diurnal rhythm, and ultimately good mental health.[11,12] Skipping breakfast on the other hand have been correlated with poor sleep quality in students.[13] All these studies were done among adolescents and children and no study has been designed to study role of breakfast on night time sleep among adults.

Therefore this study has been designed to study the relationship between breakfast omission and parameters like cognition, quality of sleep and glucose homeostasis in young adult Indian population.

AIM & OBJECTIVE

To study the effects of breakfast omission on glucose homeostasis, cognition and sleep among young adults.

- To measure and compare the anthropometric measurements in breakfast eaters and breakfast skippers.
- To estimate and compare the blood glucose profile in breakfast eaters and breakfast skippers.
- To assess and compare the cognitive abilities among breakfast eaters and breakfast skippers.
- To investigate and compare the quality and pattern of sleep in breakfast eaters and breakfast skippers.
- To compare the age at menarche between breakfast eaters and breakfast skippers.
- To study the relation between sleep, cognition and blood glucose in breakfast eaters and breakfast skippers.

REVIEW OF LITERATURE

In a day, breakfast is the first meal that is consumed so it is considered to be the most important meal of the day.[14] The name comes as breakfast as it is breaking overnight fast by supplying the body with fuel.[15] The famous saying "Breakfast like a king, Lunch like a prince, and Dine like a pauper" is followed from olden days.[16] In 1965, Almeda county came out with results of longitudinal study and referred it as 'ALMEDA 7'. It says that Almeda 7 is related to health status.7 health habits included are as follows

- Eating breakfast regularly
- 7-8 hours of sleep at night
- Exercising regularly
- Maintenance of desirable weight for height
- Avoiding snacks
- Not smoking
- Not drinking alcohol, or drinking less than 5 drinks in one sitting.[17]

On contrary, the modern lifestyle has altered the morning routine in last few years. Irregular breakfast habits and consumption of breakfast that is nutritionally inadequate breakfast has recently been observed in Indian population.[18] Comparatively, breakfast skipping habit is common among females.[19]

Some individuals skip breakfast because of the following reasons

- Not feeling hungry

- Insufficient time to get ready in the morning, or rush to school/college/office
- Waking up late
- Breakfast not prepared at home

are the common reasons quoted in previous studies. [20]

IDEAL BREAKFAST

The breakfast should be consumed within 2 hour after waking up and not later than 10.00AM in the morning.[1]An ideal breakfast provides 20-30% of total daily calorie requirement. And it should contain carbohydrate, proteins, vitamins, and essential minerals.

Breakfast habits plays an important role on various health aspects

1. Nutrition
2. Metabolism
3. Maintenance of ideal body weight
4. Role in cognitive function[15]
5. Role in glucose homeostasis
6. Role in regulation of sleep

BREAKFAST AND NUTRITION

Persons who eat breakfast when compared to the persons who do not eat breakfast, the average total energy intake was lower in the breakfast skippers which results in

nutritional inadequacy. Skipping breakfast resulted in two third decrease in intake of recommended daily allowance of vitamins, minerals and essential nutrients.[21,22] Meenakshi garg et al in their study on effects of breakfast skipping on nutritional status has found that breakfast skipper had lesser intake of nutritious foods like cereals, milk, vegetables, fruits and increased intake of junk foods rich in unsaturated fat.[23] These previous data strongly suggests the role of breakfast in nutritional adequacy.

BREAKFAST AND METABOLISM

Breakfast consumption was shown to improve metabolic responses to the next consumed meal and kick starts metabolism at the starting of the day.[24] Conversely, a randomized control study conducted by James et al showed that there was no differences in resting metabolic rate between breakfast eaters and breakfast omitters.[25] The relationship between breakfast and metabolism has not been clearly established in the previous studies.

BREAKFAST AND BODY WEIGHT

In 2011 a cross sectional study found a positive association between lower BMI and regular breakfast consumption.[19] Stalo papoutsou et al studied the association between breakfast consumption and cardio metabolic risk factors and have found that girls consuming breakfast daily had lower mean BMI and BMI Z-score. And these girls were less likely of having high triglyceride levels and high atheromatic index (total

cholesterol to HDL ratio), high diastolic pressure.[26] Katherine et al in their study investigated relation between breakfast consumption and visceral fat indices and they found that breakfast eaters had lower intra abdominal adipose tissue when compared to breakfast skippers and no significant disturbance was seen in any other adiposity measures. [27] In an analysis of 2302 school girls, they have found that overweight was highly prevalent among the students who skip breakfast.[28] A cross sectional study among medical students observed that females skip breakfast more commonly than males and students with regular breakfast habits had lower BMI.[29] Gender variations on association between breakfast and BMI was studied among Finish and Greek adolescents and shown that boys who consume breakfast regularly had lower BMI but not girls.[30] Nafis et al studied breakfast skipping and its effects on obesity on 1416 students and found that obesity and overweight was prevalent among persons who had decreased frequency of breakfast intake.[31] Individuals anxious to lose weight frequently skip breakfast. Not knowing that morning breakfast regulates metabolism maintains weight under control which is supported by the above literatures.[32]

BREAKFAST AND GLUCOSE HOMEOSTASIS

Normal plasma glucose:

An average 24 hour plasma glucose concentration is approximately about 90mg/dl, with a maximum of 165mg/dl following a meal ingestion and a minimum of 55mg/dl following exercise.[33]

- Normal Fasting plasma glucose level is less than 100mg/dl

- Normal Postprandial plasma glucose level is less than 140mg/dl.[34]

Glucose : Orgin to fate

Glucose in plasma is obtained from different sources such as

- Dietary source
- Glycogenolysis- Breakdown of stored glucose (glycogen) from the liver
- Gluconeogenesis-Formation of glucose from non- cabohydrate sources such as lactate, pyruvate, amino acids and glycerol in liver and kidney

Glucose in plasma is used by different tissues and are metabolized differently at different states

(postabsorptive, postprandial state) and they are removed from plasma by few pathways such as

- Storage of glucose as glycogen
- Glycolysis- It is of two types: Non-oxidative and oxidative.

  Non-oxidative glycolysis produce pyruvate, lactate and alanine.

  Oxidative glycolysis coverts glucose into acetyl-co-A which is further oxidized into carbondioxide and water through tricarboxylic acid cycle. Carbon compounds formed from non-oxidative glycolysis undergo gluconeogenesis to form glucose which inturn is either stored as glycogen or released into plasma.[33]

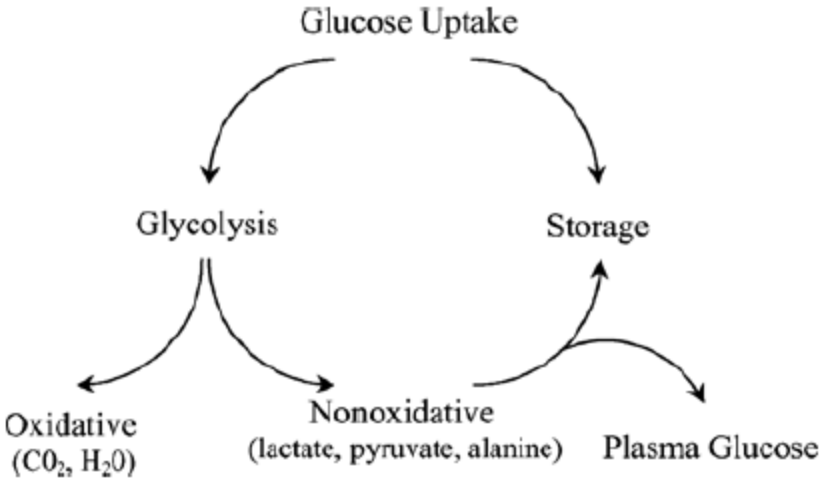


Fig 1: Fate of glucose[35]

GLUCOSE HOMEOSTASIS

Most of the tissues and organs require continuous supply of glucose as a source of energy. Decrease in glucose concentration may cause seizures, loss of consciousness and death. On the other hand, increase in blood glucose concentration can lead to blindness, renal failure, vascular disease etc. Thus the blood glucose concentration should be maintained within a narrow physiological range without any fluxes. This process of maintenance of blood glucose concentration within a physiological range is termed as glucose homeostasis.[36] Blood glucose homeostasis is achieved by the coordination of following factors

- On moment to moment basis, control of glycemia despite wide fluctuations in blood glucose is by hormones-Insulin and glucagon. [37]

- On long term basis, control of glycemia is by other hormones (growth hormone, cortisol catecholamine), sympathetic nervous system, nutritional factors, exercise and physical fitness, changes in hormonal sensitivity.[33,37]

KEY METABOLIC REGULATORS OF GLUCOSE HOMEOSTASIS

INSULIN

Insulin is a peptide hormone secreted from beta cells of pancreas.[38] Insulin secretion depends upon the concentration of plasma glucose. Increased plasma glucose concentration following meal leads to increased release of insulin within 30-60 min and decreased plasma glucose concentration less than 50mg/dl results in 80-90% reduction in plasma insulin level. Suppression of glucose and FFA release is maximally observed with plasma insulin concentration seen postprandially (40-50µU/ml) and glucose uptake is maximal at insulin concentration above 300µU/ml.[33] Intestinal factors such as gastrointestinal inhibitory peptide (GIP), glucagon like peptide (GLP) which are secreted in response to meal ingestion increases the release of insulin following meal ingestion. This is why insulin release following oral ingestion is greater than the insulin release following intravenous glucose load. This phenomenon of oral glucose induced insulin response is called as Incretin effect.[39,40]

Insulin has both direct and indirect way of regulating glucose homeostasis. Insulin binds to its receptors in the liver, kidney, muscle, and adipose tissue and activates its signal cascade of

protein kinases and regulatory proteins such as IRS-1 and IRS-2. Activation of these proteins results in

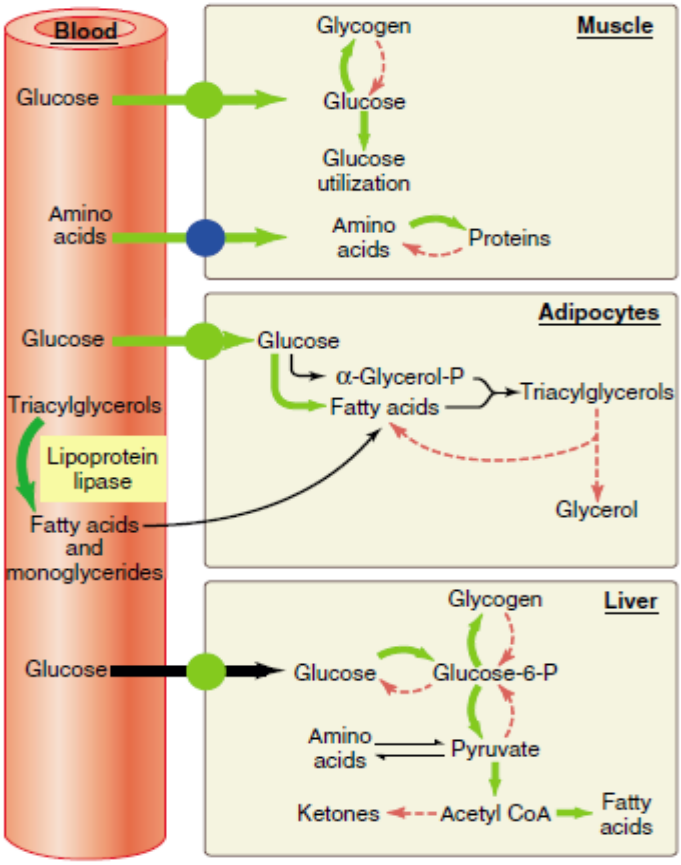


Fig.2:Actions of insulin[38]

Green arrow denotes a process stimulated by insulin, Dashed red arrow denotes inhibition by insulin. Bowed arrows denote pathways whose reversibility is mediated by different enzymes; and such enzymes are commonly the ones influenced by insulin. The black arrows are processes enhanced in the presence of insulin.

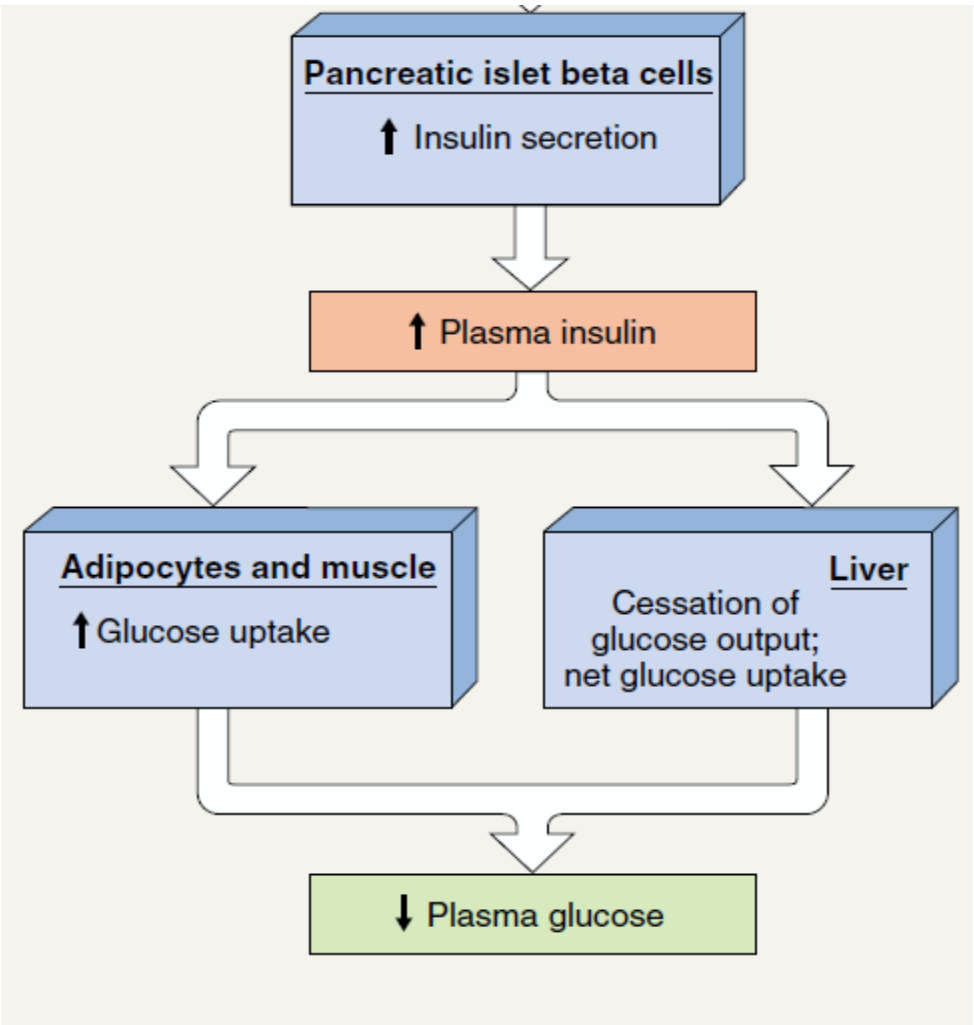


Fig 3 : Combined effects of insulin on glucose homeostasis[38]

(1) Suppression of glucose release by gluconeogenesis from liver and kidney.[33,41]

(2) Increase in glucose uptake by translocation of glucose transporters in muscle and adipose tissues.

(3) Suppression of the activity of hormone-sensitive lipase results in inhibition of release of FFA into the circulation and also there occurs increase in FFA clearance from the circulation on the other side. As FFA stimulate gluconeogenesis and reduce glucose

transport into cells, insulin by indirectly reducing FFA reduces glucose release into circulation and hastens its transport into the cells.

(4) Insulin augments glycogen storage by inhibiting glucose-6-phosphatase and phosphorylase (glycogenolysis enzymes) and by stimulating glycogen synthase.[33]

GLUCAGON

The next major hormone responsible for moment to moment regulation of plasma glucose is Glucagon which is secreted from α cells of endocrine pancreas. Glucagon secretion is controlled by many factors such as glucose (hypoglycemia stimulates and hyperglycemia inhibits), insulin, autonomic neural signals, FFA , amino acids etc.[42,,33]

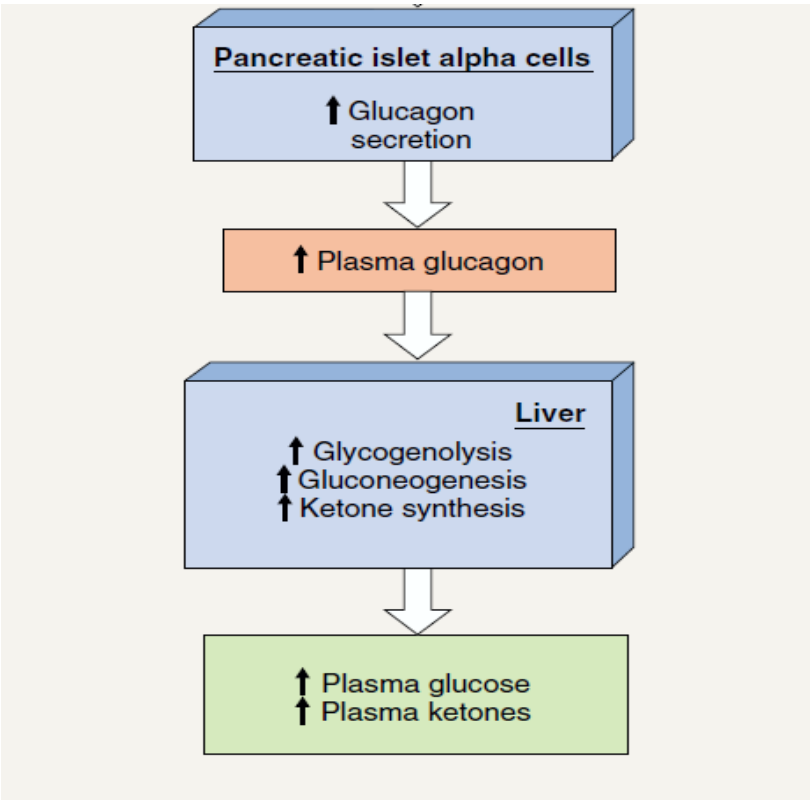


Fig 4: Combined effects of glucagon on glucose homeostasis[38]

Glucagon acts on its receptor in the liver and activates adenylyl cyclase which in turn increase intracellular cAMP . Increased intracellular cAMP stimulates emzyme phosphorylase responsible for glycogenolysis. Thus, the main action of glucagon is to increase plasma glucose by stimulating hepatic glucogenolysis immediately (immediate action). After several hours the response wanes and is followed by an increased gluconeogenesis (late action).[33]

CATECHOLAMINES

Catecholamines act as both hormones and neurotransmitter. Catecholamines release is stimulated by changes in sympathetic nervous signals during stress and hypoglycemia. These are hyperglycemic factors which increases plasma glucose level and their effects are sustained.

Catecholamine's metabolic actions are mediated through its action on beta 2 adrenergic receptors.

- In liver it mainly increases glycogenolysis via cAMP activation of phosphorylase and to lesser extent promotes gluconeogenesis.
- In kidney, catecholamines stimulates gluconeogenesis both directly and indirectly as in liver.
- In skeletal muscle, it stimulates glycogenolysis which results in increased release of lactate and decreases glucose uptake.
- In adipose tissue, it stimulates hormone sensitive lipase which stimulates lypolysis and results in increased release of FFA and glycerol.[33]

GROWTH HORMONE AND CORTISOL

Growth hormone and cortisol are antagonizers of insulin. These hormone increase the synthesis of gluconeogenic enzymes and decrease glucose transport. Thus, they decreases the ability of insulin to decrease glucose release, increase glucose uptake and inhibit lypolysis. But action of these hormones take several hours to occur in contrast to glucagon and catecholamine. These counter regulatory hormones have synergistic effects. So small increase in a couple of these hormones increase plasma glucose enormously than caused by a large increase in a single hormone level.

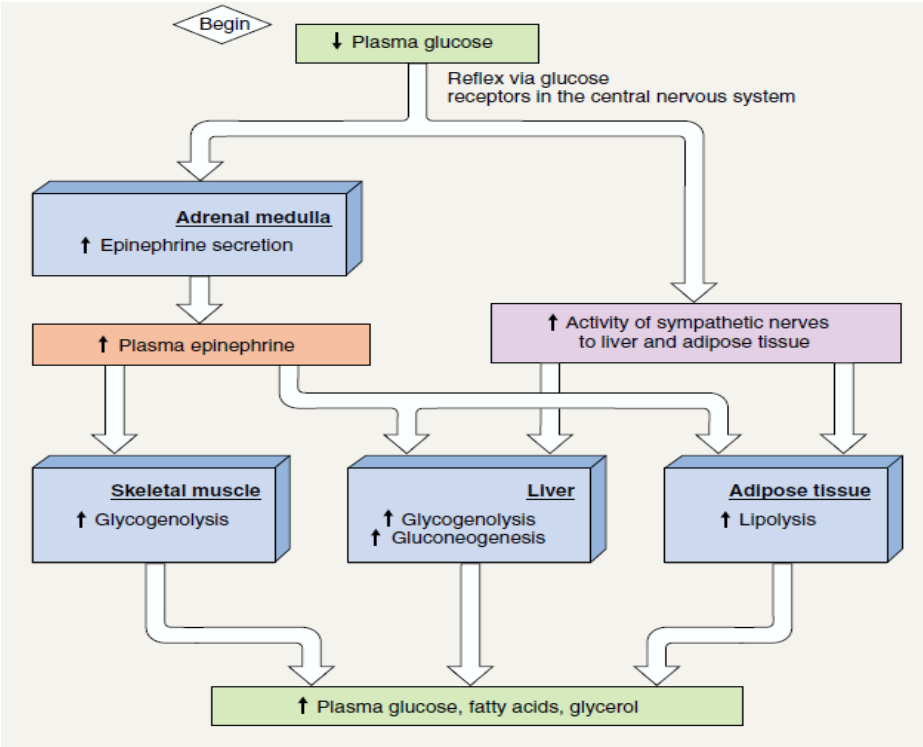


Figure 5: Action of catacholamines and sympathetic nervous system on glucose homeostasis.[38]

FREE FATTY ACID

Free fatty acids are the major fuel used by almost all the tissues except brain, renal medulla, blood cells. Free fatty acid production is regulated by sympathetic nervous activity, growth hormone, insulin, hyperglycemia. Excess FFA in plasma produces several metabolic consequences such as

- Stimulates hepatic and renal gluconeogenesis
- Decreases uptake of glucose in muscles
- Competes with glucose and acts as a oxidative fuel.

INCRETINS

Incretins are group of hormones which are released in response to meal ingestion and its main action is to stimulate the endocrine pancreas to release insulin. The first identified incretin was Gastric inhibitory peptide (GIP) which was named because of its action . The next incretin identified was glucagon like peptide (GLP) named because of its similarity to glucagon. They both are released from intestinal mucosal cells (L and K cells) within few minutes of meal ingestion and they are rapidly degraded by a proteolytic enzyme called dipeptidyl peptidase-4 (DPP-4). GLP delays gastric emptying, promotes satiety and decreases food intake thus helps in weight loss. Both GLP and GIP decrease glucagon secretion.[33]

TABLE 18-4 Summary of Glucose-Counterregulatory Controls*

	Glucagon	Epinephrine	Cortisol	Growth Hormone
Glycogenolysis	√	√		
Gluconeogenesis	√	√	√	√
Lipolysis		√	√	√
Inhibition of: glucose uptake by muscle cells and adipose-tissue cells			√	√

*A √ indicates that the hormone stimulates the process; no √ indicates that the hormone has no major physiological effect on the process. Epinephrine stimulates glycogenolysis in both liver and skeletal muscle, whereas glucagon does so only in liver.

Fig 6: Summary of glucoregulatory control.[38]

DISORDERS OF GLUCOSE HOMEOSTASIS

Defects in glucose homeostasis result in the following conditions

- Hyperglycemia-which may be due to prediabetes, Type 1 Diabetes mellitus, Type 2 diabetes mellitus, gestational diabetes mellitus, MODY, Neonatal diabetes mellitus.
- Hypoglycemia-which may be due to reactive hypoglycemia, fasting hypoglycemia.[36]

BREAKFAST AND GLUCOSE HOMEOSTASIS

Regular food intake is vital for maintenance of normal glucose homeostasis.[43] In 1991, Michaud C et al, assessed the impact of breakfast habit on blood glucose,

mood, short-term memory and concentration in 319 adolescents (age 13-20 years).They found that high energy breakfast have beneficial effect on short-term memory and no effect on blood glucose levels.[44] In 2009**,** Midori nishyama et al studied relationship between unhealthy behaviours like smoking and skipping breakfast habit and its association with prevalence of diabetes mellitus by a cross sectional study conducted on 493 subjects and found that the combined breakfast skipping and smoking habits are positively correlated with prevalence of diabetes mellitus.[45] In 2011, Yulan li et al examined 2331 non diabetic asymptomatic adults and found out that breakfast skipping habit was associated with impaired fasting glucose level.[43]

In 2012, Rania A Mekary et al assessed association between eating pattern and type 2 diabetes risk in men in a cohort of 29,206 US men who were non diabetic, not having history of cardiovascular disease, and cancer in the Health Professionals Follow-Up Study and were followed up for 16 yrs. At the end of 16yr follow up breakfast omission habit was positively associated with an increased risk of T2D in men. They have explained that breakfast decreases the risk for Diabetes mellitus by decreasing the body weight and also by being the most satiating meal.[46] In 2013**,** Andrew O. Odegaard et al, assessed the breakfast frequency and its relationship on development of metabolic risk in 3,598 participants from the community-based Coronary Artery Risk Development in Young Adults (CARDIA) study who were non-diabetic in 7 year study period and followed up them for 18years. They found that frequent (4–6 days/week) and daily (7 days/week) breakfast consumption was correlated with a decreased risk of developing

abdominal obesity, metabolic syndrome, hypertension, and type 2 diabetes during 18 years of follow-up compared to infrequent breakfast consumption (0–3 days/week).[47]

In 2014**,** Fumi Kobayashi et al investigated the effects of breakfast skipping habits on diurnal variation of energy metabolism and blood glucose and have shown that breakfast skipping did not affect 24 h energy expenditure, fat oxidation and thermic effect of food, but overall 24 h average blood glucose was increased.[48] In 2016 Maureen T. Timlin et al explained that regular breakfast consumption leads to appetite control thus in turn controls weight gain and risk for diabetes and cardiovascular disease.

Mayu Uemura et al conducted a prospective study among middle aged Japanese men and women and they followed 4631 participants from 2002 to 2011 for the development of type 2 diabetes mellitus. They found that breakfast skipping was positively associated with risk of type 2 diabetes mellitus incidence independent of BMI and FBG.[49] The relation between breakfast habit and glucose homeostasis was inconsistent in the previous studies.

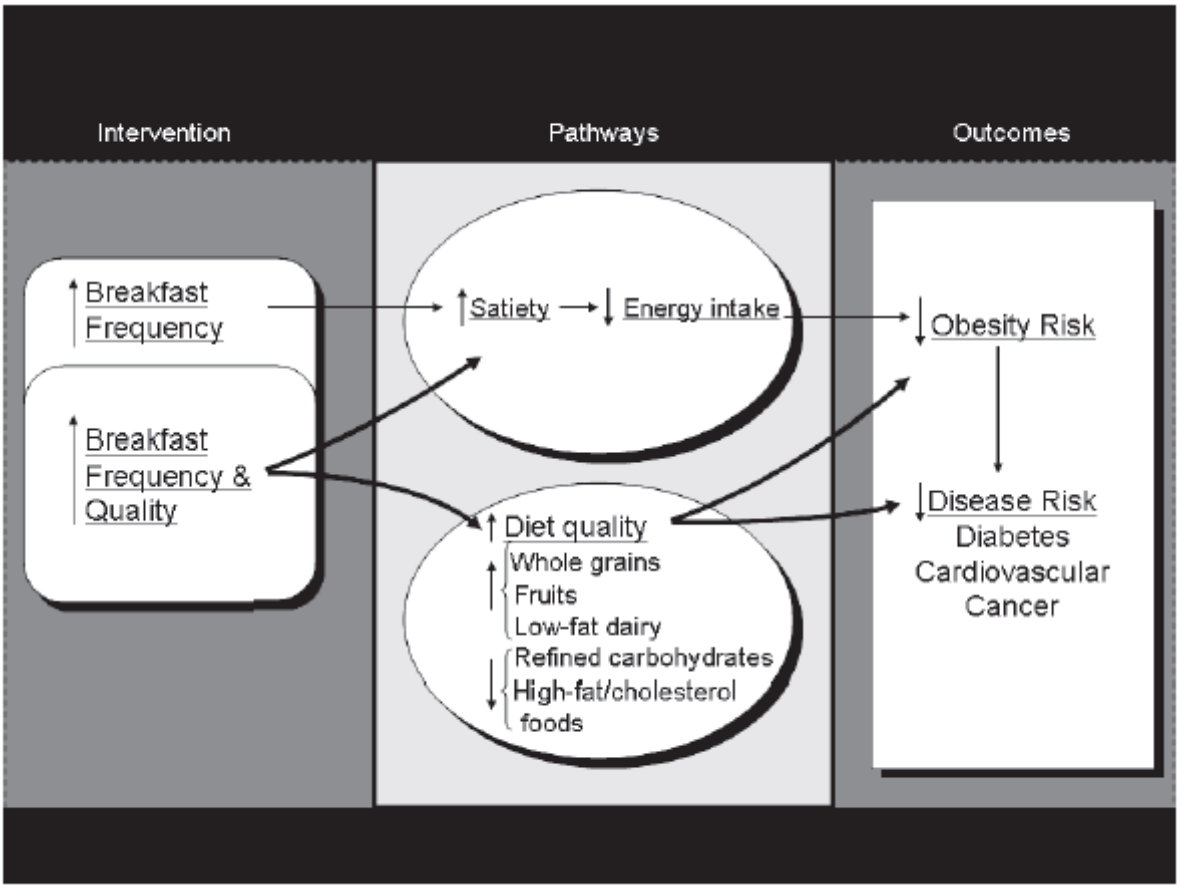


Fig 7: Physiological mechanism underlying the effects of decreased frequency of breakfast on development of obesity and chronic diseases.[1]

COGNITION

The miscellaneous functions of the association cortices are collectively termed as cognition. Association cortex includes most of the cerebral surface of human brain and they are responsible for the complex processing that occurs between the input in the primary sensory cortices and the generation of behavioral response.“Cognition” is not the best word to indicate wide range of neural functions of association cortex but it has become part of the functioning terms of neurologists and neuroscientists.

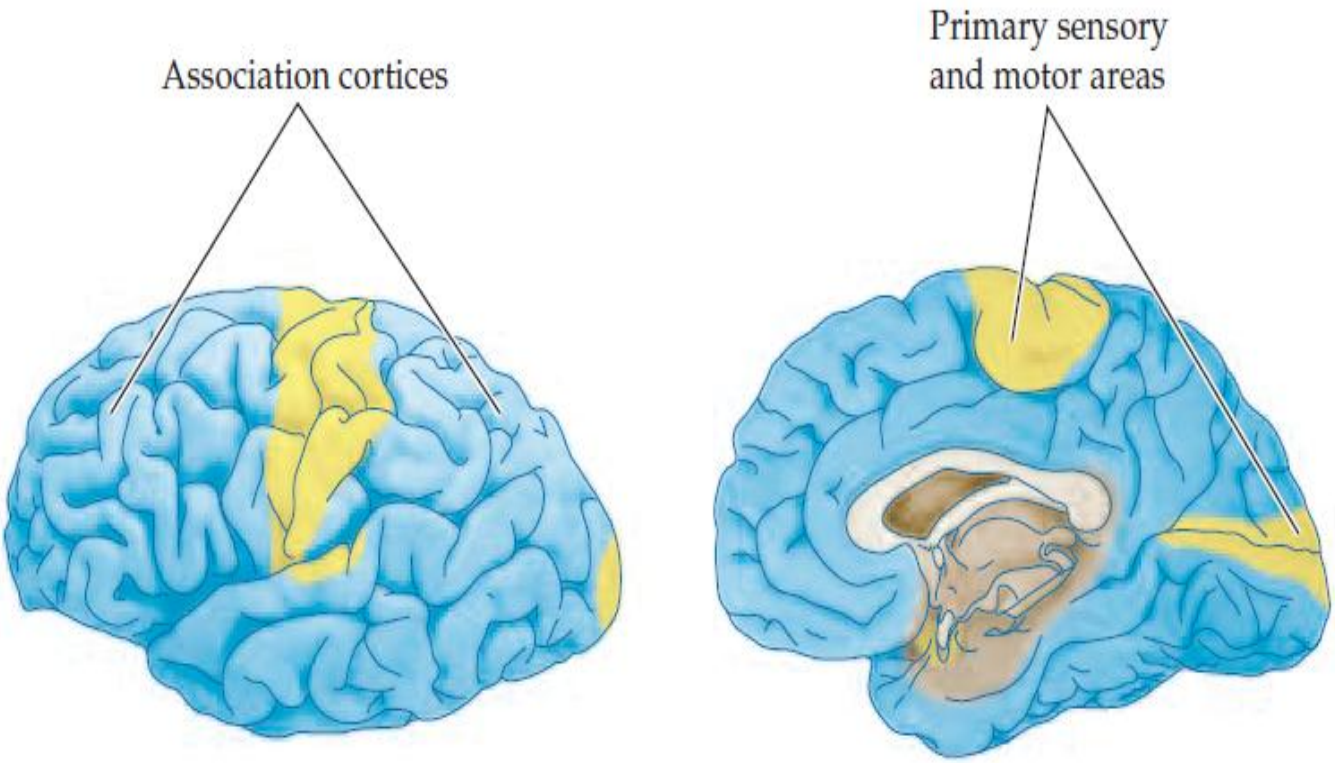


Fig 8: Area of association cortex in medial and lateral views of human brain. Blue shaded areas are association cortex, yellow shaded areas are primary sensory and motor areas.[50]

Cognition refers to the process by which we attend to external stimuli or internal motivation; recognize the importance of such stimuli; and make an appropriate response on that complex stimuli.

The association cortices receive information from a variety of sources and integrate and cause appropriate changes in cortical and subcortical targets. Association cortices receive input from the primary and secondary sensory and motor cortices, the thalamus, and the brainstem. Association cortices send output to reach the hippocampus, the basal ganglia and cerebellum, the thalamus, and other association cortices. Studies

indicate that the vital area for attending to stimuli in the external and internal environment is the parietal association cortex, and vital for identifying the nature of stimuli is temporal association cortex, and the one crucial for planning appropriate behavioral responses is frontal association cortex.

In earlier days before PET scanning and functional MRI were invented, to evaluate normal and abnormal cognitive function, several methods were used. Those methods were reliable in evaluating cognitive abilities in humans. In late 1940s, to evaluate the integrity of cognitive function and to localize lesions ,psychologists and neurologists designed a battery of behavioral tests—called neuropsychological tests.

In some tasks the patients were asked to identify familiar faces from a set of pictures, and in some tasks patients were asked to attend to stimulus in which "distractors" interfere with the

ability to attend. One of its kind is the Stroop Interference Task, in which patients have to read the names of colors printed in color-conflicting form (for ex, the word "blue" printed in green ink). This test assess both attention and identification abilities. [50]

Cattell-Horn-theory forms the basis for cognitive abilities. Woodcock Johnson III (WJ III) is based on CHC theory and it is used for measuring general intellectual ability, specific cognitive abilities, oral language and academic performance.[51]

There are nine different cognitive abilities :

- Comprehension knowledge (Gc)
- Fluid intelligence (Gf)
- Short term memory (Gsm)

- Long-term retrieval (Glr)
- Processing speed (Gs)
- Visual-spacial thinking (Gv)
- Auditory processing (Ga)
- Quantitative ability (Gq)
- Reading writing ability (Grw)

COMPREHENSION–KNOWLEDGE (Gc)

It includes verbal communication skills, information and reasoning ability, breadth and depth of knowledge.

QUANTITATIVE KNOWLEDGE (Gq)

Quantitative knowledge (Gq) is the ability to understand quantitative concepts and relationships; the competence to manipulate numerical symbols.

READING–WRITING (Grw)

It is an ability in areas including basic reading and writing skills, and the skills necessary for understanding and expression.

LONG-TERM RETRIEVAL (Glr)

Long-Term retrieval is an ability to pile up information and retrieve it later.

VISUAL–SPATIAL THINKING (Gv)

The ability to analyze, synthesize visual stimuli and to manipulate mental images.

AUDITORY PROCESSING (Ga)

The capability to discriminate, analyze, and synthesize auditory stimuli.

FLUID REASONING (Gf)

It is an capability to reason and unravel problems involving information or procedures which are unfamiliar.

PROCESSING SPEED (Gs)

It is an ability to perform different cognitive tasks rapidly and effectively

SHORT-TERM MEMORY (Gsm)

The ability to store information in immediate awareness and then retrieve it within a few seconds. [52]

Description of Nine Cattel–Horn–Carroll (CHC) Broad Abilities

CHC Broad Ability	*Description*	*Implications of Deficits*
Acquired knowledge:		
Comprehension–knowledge (Gc)	The breadth and depth of knowledge, including verbal communication, information, and reasoning when using previously learned procedures.	Lacks information, language skills, and knowledge of procedures.
Quantitative knowledge (Gq)	The ability to comprehend quantitative concepts and relationships; the facility to manipulate numerical symbols.	Difficulty with arithmetic and other numerical tasks; poor at handling money and making change.
Reading–writing (Grw)	An ability in areas common to both reading and writing; probably includes basic reading and writing skills, and the *skills* required for comprehension and expression.	Difficulty with word attack, reading comprehension, or other basic reading skills; writing is inconsistent and characterized by errors of spelling and usage and of poor expression.
Thinking abilities:		
Long-term retrieval (Glr)	The ability to efficiently store information and retrieve it later.	Difficulty in recalling relevant information and in learning and retrieving names; needs more practice and repetition to learn than peers; inconsistent in remembering previously learned material.
Visual–spatial thinking (Gv)	Spatial orientation, with the ability to analyze and synthesize visual stimuli and to hold and manipulate mental images.	Poor spatial orientation; misperception of object–space relationships; difficulty with art and using maps; tendency to miss subtle social and interpersonal cues.
Auditory processing (Ga)	The ability to discriminate, analyze, and synthesize auditory stimuli.	Speech discrimination problems; poor phonological knowledge; failure in recognizing sounds; increased likelihood of misunderstanding complex verbal instructions.
Fluid reasoning (Gf)	The ability to reason and solve problems often involving unfamiliar information or procedures, which is manifested in the reorganization, transformation, and extrapolation of information.	Difficulty in grasping abstract concepts, generalizing rules, and seeing implications; has difficulty changing strategies if first approach does not work.
Cognitive efficiency:		
Processing speed (Gs)	Speed and efficiency in performing automatic or very simple cognitive tasks.	Slow in executing easy cognitive tasks; slow acquisition of new material; tendency to become overwhelmed by complex events; needs extra time in responding to well-practiced tasks.
Short-term memory (Gsm)	The ability to hold information in immediate awareness and then use it within a few seconds.	Difficulty in remembering just-imparted instructions or information; easily overwhelmed by complex or multistep verbal directions.

Fig 9: Description of cognitive abilities[52]

BREAKFAST AND COGNITION

In 1991, Michaud C et al, assessed the impact of breakfast habit on blood glucose, mood, short-term memory and concentration in 319 adolescents (age 13-20 years).They found that high energy breakfast has beneficial effect on immediate recall in short-term memory but concentration was impaired and they have shown no effect on morning mood. These results suggest that breakfast size has different effect on cognitive function.[41] In 1993, López I et al studied the effects of breakfast omission on cognitive performance in 279 children from low socio economic status and grouped them nutritionally as: normal, wasted or stunted and they have found no correlation between breakfast omission and performance in short-term visual memory, problem solving and attention tasks in all the nutritional groups. Stunted children were affected in attention test irrespective of receiving breakfast or not. These results imply that missing breakfast do not influence the cognitive performance of children.[53]

In 2008, Gajer et al analyzed breakfast eating habit and its effects on attention concentration, immediate memory and school achievement in 379 middle class students aging 11-13 and found that regular breakfast consumption was positively correlated with 1.4% improved letter cancelation scores and 4.3% higher immediate memory recall compared to breakfast skipping and concluded that breakfast eating habit has beneficial influence on attention, concentration, immediate memory and school performance.[54]

In 2013, Tanya Zilberter et al studied effects of breakfast on cognition in children and adults, and found different effects like positive cognitive effects, negative cognitive

effect and also no influence of skipping breakfast in different groups. They concluded that impact of breakfast on cognition in children depends on BF composition (macronutrients, GI, calories), nourishment (malnourished, well-nourished, obese) and IQ. In adults, impact of breakfast on cognition depends on BF composition and glucose tolerance.55 In 2013**,** Jianghong Liu et al, investigated regular breakfast habits and its association with IQ in a sample of 1269 children (697 boys and 572 girls) aged 6 years with parental questionnaire for dietary assessment and revised Chinese version of the Wechsler Preschool and Primary Scale of Intelligence for cognition assessment. They found that children who regularly consumed breakfast had appreciably higher verbal, and performance IQ test scores compared to children who consume breakfast irregularly.[56]

SLEEP

Sleep and wakefulness are one among the many functions of the body that show circadian (about one day) periodicity. Changes in behavioral state during the sleep-wake cycle is associated with distinctive changes in the EEG

There are two phases of sleep

NREM (nonrapid eye movement)

REM (rapid eye movement) sleep.

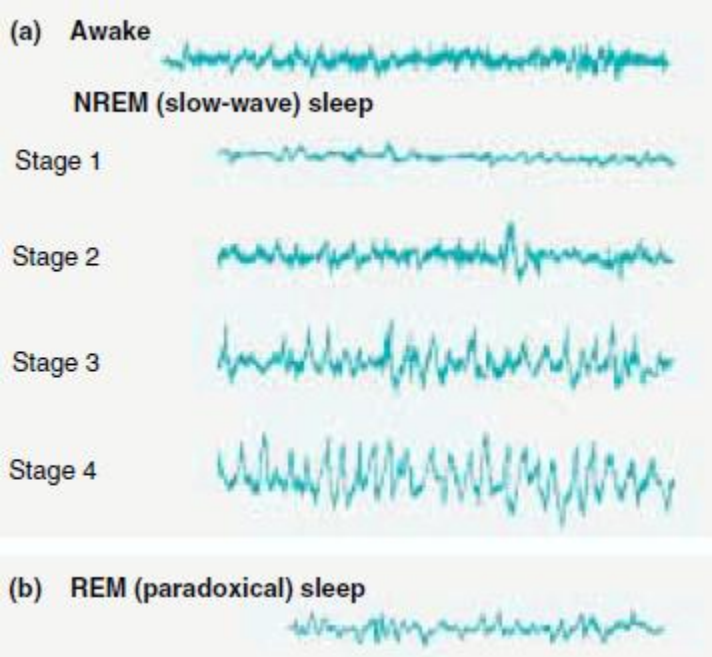


Figure.10 The EEG record of a person (a) passing from the awake state to deep sleep (stage 4) and (b) during REM sleep.[57]

The EEG waves during NREM sleep are of high amplitude and low—frequency, and hence it is also referred to as slow-wave sleep. NREM sleep is divided into four stages from one to four each successive stage having an EEG pattern characterized by a slower frequency and higher amplitude than the preceding one as shown in fig.9.

EEG during REM sleep is low-voltage, high-frequency, and has asynchronous pattern characteristic of the alert, awake state . REM sleep is also termed as **paradoxical sleep** because it is difficult to arouse despite having an EEG that is characteristic of the alert, awake state. Dreaming occurs during REM sleep.

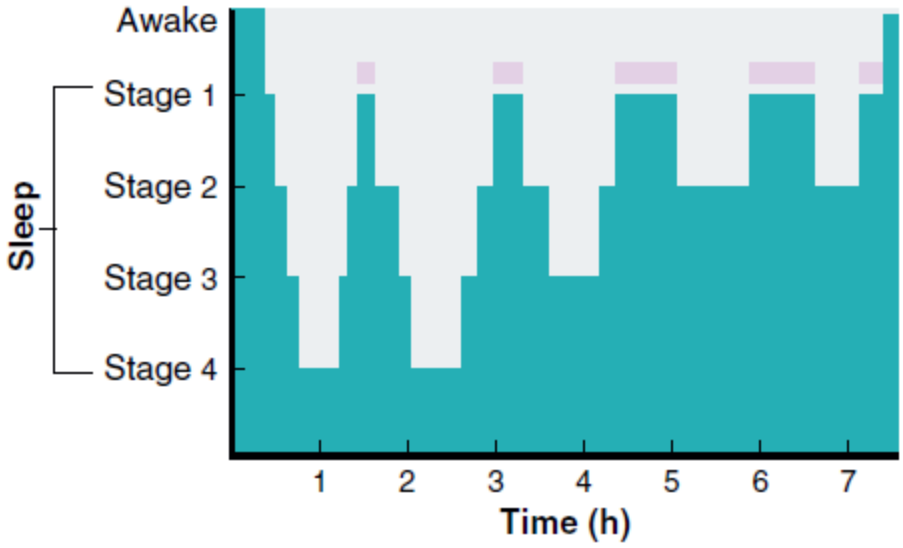


Fig 11: Stages of night's sleep in an average young adult. The lavender colored lines denotes periods of REM sleep[57]

If uninterrupted, sleep consist of cyclical stages moving from 1, 2, and 3, to 4 then back up from 4 to 3, 2, and 1, where NREM sleep is punctuated by an episode of REM sleep. Continuous monitoring of adults show that during average total sleep period there is four or five such cycles, each lasting 90 to 100 min. NREM constitutes 75 to 80 percent of the total sleeping time,the remainder is spent in REM sleep. The time spent in REM sleep is more towards end of an undisturbed sleep. Initially, when one moves from drowsiness to stage 1 sleep, there is a considerable tension in the postural muscles, but the muscles become gradually more relaxed as NREM sleep progresses.

During the sleep cycle, in addition to altered muscle tension various changes occur throughout the body. During NREM sleep, there is pulsatile releases of growth hormone and the gonadotropic hormones from the anterior pituitary, and decreases in blood

pressure, heart rate, and respiratory rate. REM sleep is related with an increase and irregularity in blood pressure, heart rate and respiratory rate, twitches of the facial muscles or limb muscles also may occur.[57]

Evaluation of quality and pattern of sleep can be assessed by The Pittsburgh Sleep Quality Index (PSQI) which measures seven components of sleep such as Subjective sleep quality, Sleep latency, Sleep duration, Habitual sleep efficiency, Sleep disturbances, Use of sleeping medications, Daytime dysfunction.[58]

BREAKFAST AND SLEEP

Cynthia V. Lentino et al examined 14,148 US Army Active, Reserve, and National Guard members and found that poor sleepers are those who are less likely to eat their morning breakfast and proved that there is a definite relation between breakfast habits and sleep.[59] In 2009 Midori nishiyama et al investigated unhealthy behaviors among breakfast skippers and he has found that subjects who skip breakfast had poor quality of sleep compared to the person regularly consuming breakfast.[45]

Cheng et al in 2011 assessed 4318 undergraduate female students and classified poor sleep quality group by a PSQI score ≥ 6 and he found that poor sleep quality was significantly associated with skipping breakfast habit.[60] In 2013, Juan sun et al conducted a cross sectional study among medical students and found a positive association between breakfast omission habit and quality of sleep.[61] In 2016, lan wang et al assessed the relationship between sleep quality and associated behaviours that lead to sleep

disturbance at Mongolia medical university. They found that 27.8% (1694) of students had poor sleep quality and it was found to be associated with major risk factors like poor academic performance, poor interpersonal relationships, physical exercise less than three times a week and skipping breakfast.[62]

MATERIALS AND METHODS

STUDY DESIGN: Observational study

STUDY SETTING: This study was conducted at Chennai medical college hospital and research centre, Trichy . Recording of physiological parameters, clinical examination, cognitive tasks were performed at the department of Physiology. Fasting and Postprandial blood glucose estimation was carried out at the Biochemistry laboratory, CMCH&RC.

STUDY DURATION: 1year

STUDY PARTICIPANTS: (N=106)

106 Healthy volunteers (53 subjects who regularly consume breakfast, 53 subjects who skip breakfast more than 3 days a week) were included in this study.

Sample size was calculated using the formula

$n = (Z_{\alpha/2}+Z_{\beta})^2 * (p_1(1-p_1)+p_2(1-p_2)) / (p_1-p_2)^2$,

where $Z_{\alpha/2}$=critical value of the Normal distribution at $\alpha/2$ (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96),

Z_{β} = critical value of the Normal distribution at β (e.g. for a power of 80%, β is 0.2 and the critical value is 0.84)

p_1 and p_2 are the expected sample proportions of the two groups.

p_1 and p_2 were taken from the previous study, where p1=17.9 and p2=42.1 [45]

INCLUSION CRITERIA:

- Young adults (18-39 yrs) [32]
- Both gender
- Persons who skip breakfast at least 3 days a week(breakfast skippers group)[2]
- Person who regularly consume breakfast(breakfast eaters)

EXCLUSION CRITERIA:

- Chronic medical illness on medication
- Color blindness
- Sleep disorder
- Psychiatric disturbances
- Drug therapy
- Smoking
- Alcoholism
- Drug abuse
- Pregnancy and lactation

METHODOLOGY:

Ethical clearance was first obtained from institutional ethics committee of CMCH&RC. After initial screening of volunteers for inclusion and exclusion criteria, they were further classified into breakfast eaters and breakfast skippers based on a comprehensive history taken by the investigator regarding details of breakfast consumption. Procedure of the study was explained to all the participants in detail in their own regional language and written informed consent was obtained for their participation in the study. Following which the study was initiated.

The study protocol included

- Recording general medical history and history regarding breakfast habits.
- Recording of Anthropometry measurements.
- Recording of Physiological parameters.
- Assessment of Quality and pattern of sleep by standardized questionnaire.[58]
- Evaluation of Cognitive Function by a standardized battery of tests included in woodcock Johnson tests for cognitive abilities (WJ III-COG).[51]
- Estimation of plasma glucose in venous sample (fasting and postprandial) by glucose oxidase method.[63]

Participants personal details such as name, age, address, occupation were collected. Diet history, general medical history, drug history, family history of diabetes mellitus,

menstrual history in case of females and personal history were collected. General examination was carried out.

RECORDING OF ANTHROPOMETRY MEASUREMENTS

Height in meters was measured using stadiometer and weight in kilogram was measured using standard analog weighing scale and BMI was calculated by the formula weight(kg) /height (m^2). Classification of adults according to BMI was done using the WHO guidelines as follows .[64]

Classification	BMI	Risk of comorbidities
Underweight	<18.50	Low (but risk of other clinical problems increased)
Normal range	18.50–24.99	Average
Overweight:	≥25.00	
Preobese	25.00–29.99	Increased
Obese class I	30.00–34.99	Moderate
Obese class II	35.00–39.99	Severe
Obese class III	≥40.00	Very severe

Table 1:Classification of adults according to BMI[64]

Waist circumference was measured at midpoint between the lower margin of the last rib and the highest point of the iliac crest and hip circumference was taken around the widest

portion of the gluteal region using standard inch tape and waist hip ratio (WC:HC) was calculated using formula WHR= Waist circumference/ Hip circumference. Sex specific cut off points for classifying increased risk of metabolic risk was adopted from WHO guidelines.[65]

Indicator	Cut-off points	Risk of metabolic complications
Waist circumference	>94 cm (M); >80 cm (W)	Increased
Waist circumference	>102 cm (M); >88 cm (W)	Substantially increased
Waist–hip ratio	≥0.90 cm (M); ≥0.85 cm (W)	Substantially increased

M, men; W, women

Table 2: World Health Organization cut-off points and risk of metabolic complications.[65]

RECORDING OF PHYSIOLOGICAL PARAMETERS

Resting pulse rate was calculated by manually counting the radial pulse for one minute and blood pressure was recorded at sitting posture in right upper arm by both palpatory and auscultatory method using diamond deluxe sphygmomanometer and elkon el-tone stethoscope.

ASSESSMENT OF QUALITY OF SLEEP

Quality and pattern of sleep was assessed by a self rated subjective questionnaire- The Pittsburgh Sleep Quality Index (PSQI)**.** It included measurement of seven areas (components) of sleep over the past one month period:

- Subjective sleep quality
- Sleep latency
- Sleep duration
- Habitual sleep efficiency
- Sleep disturbances
- Use of sleeping medications
- Daytime dysfunction over the last month

Measurement of these components differentiate "good" sleep from "poor" sleep. A total score of global PSQI greater than "5" is indicative of poor sleep quality. PSQI score more than 5 indicates that there is severe difficulty in at least two areas or moderate difficulty in more than three areas. PSQI is a validated questionnaire having a chronbach's α of 0.83.[58]

EVALUATION OF COGNITION FUNCTION

Cognitive functions in young adults were assessed using two sets of studies

1. By a reliable and validated tool called "Woodcock Johnson battery of cognitive abilities" which was developed based on Catell-Horn-theory of cognitive

abilities.[66] The tests that were recruited from WJ-III for assessment of cognitive functions were

- Letter cancellation task
- Pair cancellation task
- Digit span task
- Trial making task
- Mental arithmetic task.[51]

LETTER CANCELLATION TASK

A sheet of paper containing six line of 52 alphabets and pen was given to the subject and they were asked to search for the letter "B" and strike out as soon as possible.[67] Scoring was done depending on the time taken to complete the task and the number of errors.[68,69] This task measures the perceptual speed which denotes the processing speed (Gs) in WJ III.[51]

PAIR CANCELLATION TASK

A sheet of paper containing different patterns of drawings (i.e.,dog,ball,cup) arranged randomly was given with a pen and they were instructed to mark the pairs similar to the given target pair(ball followed by a dog) as rapidly as possible. Scoring was done by including the time taken to complete the test and errors. This test measures the attention and concentration which denotes the processing speed (Gs) in WJ-III.[51,70]

DIGIT SPAN TASK

It consists of two parts : Forward digit span task and backward digit span task

Forward Digit Span: Subjects were instructed to repeat the set of numbers in same order as called out by the examiner at a speed of one digit per second and number of digits in each lines keeps increasing till the subjects were unable to repeat. The number of lines correctly repeated by the subjects were noted

Backward digit span task: Subjects were instructed to repeat set of numbers in the reverse order when called out by the examiner and number of lines correctly repeated in reverse order was noted.[71] This task assesses working memory which denotes the cognitive ability Short term memory as in WJIII[51]

TRIAL MAKING TASK

It consists of two tests: TRIAL A and TRIAL B

In TRIAL A-The subjects were instructed to trace and join numbers from 1 to 25 in ascending order from a disarrayed numbers without removing pen or retracing any lines under time pressure.

In TRIAL B-The subjects were asked to trace and join numbers in ascending order along with tracing alphabets orderly from a disarrayed set of numbers and letters (ex. 1-A-2-B-3-C-4-D….) and time taken to complete the test was noted. [72]

Trial making task assess the special scanning ability and general sequence reasoning as stated as visual spatial thinking (Gv) and fluid reasoning (Gf) in WJ III.[51]

MENTAL ARITHMETIC TASK

Subjects were required to do serial subtraction of 7 from 37 under time pressure. This test assess the mathematic fluency (Gq) in WJ III[51]

2. By a Stroop task- In which words (names of colors/some words) were presented in colored ink, and the subject was asked to name the color of the ink as quickly as possible. The ink color may either match or conflict with the color name. Time taken were measured and wrong responses were corrected during the test period itself.[73] Test included three parts
    - RCNb(Neutral)- subjects were instructed to call out the ink colour of the 100 neutral words (BLOOD as red)
    - RCNc(Congruent)-subjects were instructed to call out the ink of 100 words in which the word and the ink colour were same(GREEN as green)
    - RCNd(Incongruent)-subjects were instructed to call out the ink of 100 words in which the word and the ink colour were different(ORANGE as purple).[74]

ESTIMATION OF PLASMA GLUCOSE

Following overnight fast of 8 hours, venous blood was withdrawn from the subjects and stored in a vacutainer containing sodium fluoride for estimation of fasting plasma glucose.[75] Then subjects were asked to drink 75g of anhydrous glucose dissolved in water and blood was drawn after 2hours of glucose load and stored in sodium fluoride containing vacutainer.[34] Collected samples were transferred within 10 to 15 min of

sample collection to biochemistry laboratory for accuracy.[76] Plasma glucose level was estimated in the fasting and two hour post glucose load collected sample using autoanalyser (mindray-B420) by glucose oxidase method.[63]

CRITERIA FOR DIAGNOSIS OF DIABETES MELLITUS

FPG ≥126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.

OR

2-h PG ≥200 mg/dL (11.1 mmol/L) during an OGTT.

CRITERIA FOR DIAGNOSIS OF PREDIABETES (IFG/IGT)

FPG ≥100–125 mg/dL (5.6–6.9mmol/L)

2-h PG ≥140–199 mg/dL (7.8–11.0mmol/L) during an OGTT.[34]

TABLE 3: DESCRIPTIVE ANALYSIS

Variables	Total (n=106)				B-Eater (n=53)				B-Skipper (n=53)			
	Min.	***Max.***	***Mean***	***S.D***	***Min.***	***Max.***	***Mean***	***S.D***	***Min.***	***Max.***	***Mean***	*S.D*
Age	18	35	23.42	5.501	18	35	24.23	6.018	18	34	22.62	**4.857**
Menarche	0	17	8.91	6.499	0	15	8.74	6.383	0	17	9.08	**6.670**
Height	130	190	162.68	9.826	147	190	164.06	9.050	130	187	161.30	**10.449**
Weight	37	110	61.80	15.496	41	110	67.30	16.191	37	90	56.31	**12.697**
BMI	14.45	38.00	23.1633	4.38827	16.40	38.00	24.8319	4.65704	14.45	29.40	21.4947	**3.39422**
WC	56	125	83.10	12.475	63	125	88.02	11.732	56	105	78.19	**11.288**
HC	60	136	95.16	12.717	71	136	100.17	12.097	60	116	90.15	**11.359**
WC:HC	1	1	.87	.064	1	1	.87	.070	1	1	.86	**.056**
PSQI	0	14	4.30	3.002	0	9	3.57	2.422	1	14	5.04	**3.351**
PSQI	1	2	1.31	.465	1	2	1.26	.445	1	2	1.36	**.484**
DST	6	17	12.07	2.431	8	17	12.72	2.125	6	17	11.42	**2.560**
TM-A	15	62	32.61	10.706	15	56	31.23	9.190	17	62	33.99	**11.962**
TM-B	32	130	67.51	20.090	32	129	64.77	18.220	36	130	70.25	**21.628**
LCT	39	119	58.00	13.246	40	84	58.06	10.987	39	119	57.94	**15.284**
PCT	45	120	72.57	15.265	50	116	71.30	14.143	45	120	73.83	**16.347**
RCNb	31	182	58.11	18.452	31	102	58.75	15.763	35	182	57.47	**20.933**
RCNc	19	85	35.86	11.268	19	85	35.42	11.901	21	61	36.30	**10.693**
RCNd	25	166	78.38	22.452	25	153	75.68	21.770	46	166	81.08	**23.002**
MAT	9	107	19.87	10.941	9	107	19.35	13.744	9	42	20.38	**7.230**
FBG	51	248	84.59	24.517	51	248	87.85	30.163	52	119	81.34	**16.803**
OGT	**65**	**397**	**108.96**	**38.446**	**65**	**397**	**117.06**	**49.681**	**76**	**150**	**100.87**	**19.567**

Table 3 shows descriptive statistics of all the parameters that has been studied in breakfast eaters and breakfast skippers.

DEMOGRAPHIC PROFILE

A total of 106 participants were enrolled in the study. Out of which 53 subjects are regular breakfast eaters and 53 subjects are breakfast skippers.

TABLE 4: AGE

Group	Mean Age(SD)	95% CI	p-value
Breakfast eaters	24.23(6.018)	-0.503 to 3.710	**0.134**
Breakfast skippers	22.62(4.857)		

CHART 1: COMPARISON OF AGE OF STUDY PARTICIPANTS

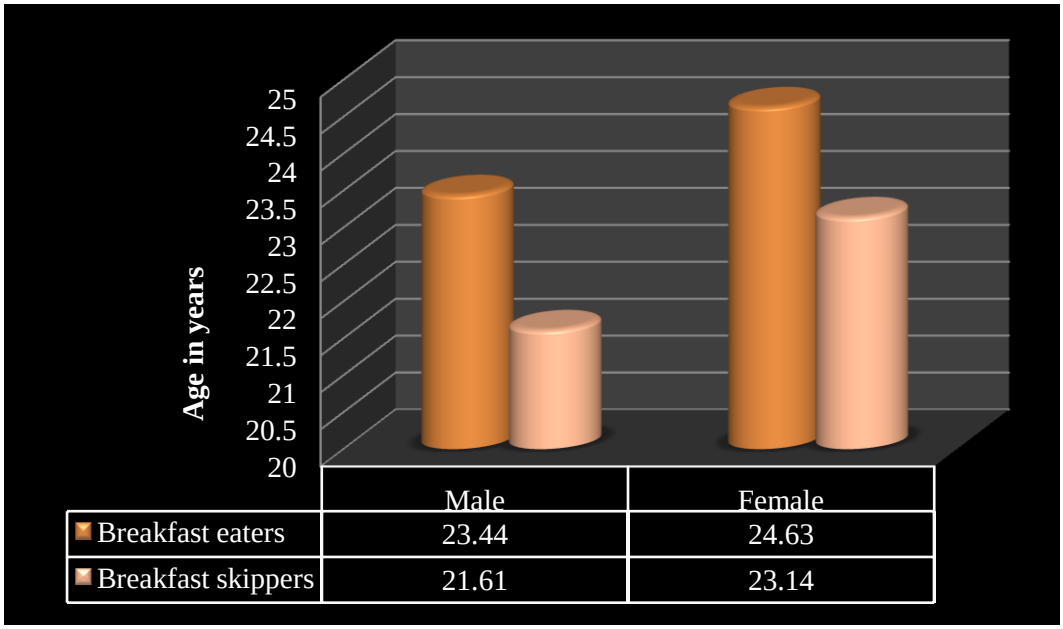


Table 4 shows mean age of breakfast eaters being 24.23 years, minimum age was 18 years and maximum age was 35years and mean age of breakfast skippers being 22.62 years, minimum age was 18 years and maximum age was 34 years. There was no statistically significance in age between the two groups. The comparison of age between two group is represented in chart 1.

TABLE 5: GENDER

Group	Sex					
	Male		Female		Total	
B-Eater	18	50.0%	35	50.0%	53	**50.0%**
B-Skipper	18	50.0%	35	50.0%	53	**50.0%**
Total	36	100.0%	70	100.0%	106	100.0%

Table 5 shows that 53 subjects participated in both the group, out of which 18 were male and 35 were female in each group.

TABLE 6: PARTICIPANTS OF BREAKFAST SKIPPERS GROUP

Gender	N	Mean	S.D	Statistical inference
Male	18(34%)	21.61	4.340	**0.291**
Female	35(66%)	23.14	5.083	

CHART 2: DISTRIBUTION OF PARTICIPANTS BY GENDER IN BREAKFAST SKIPPERS GROUP

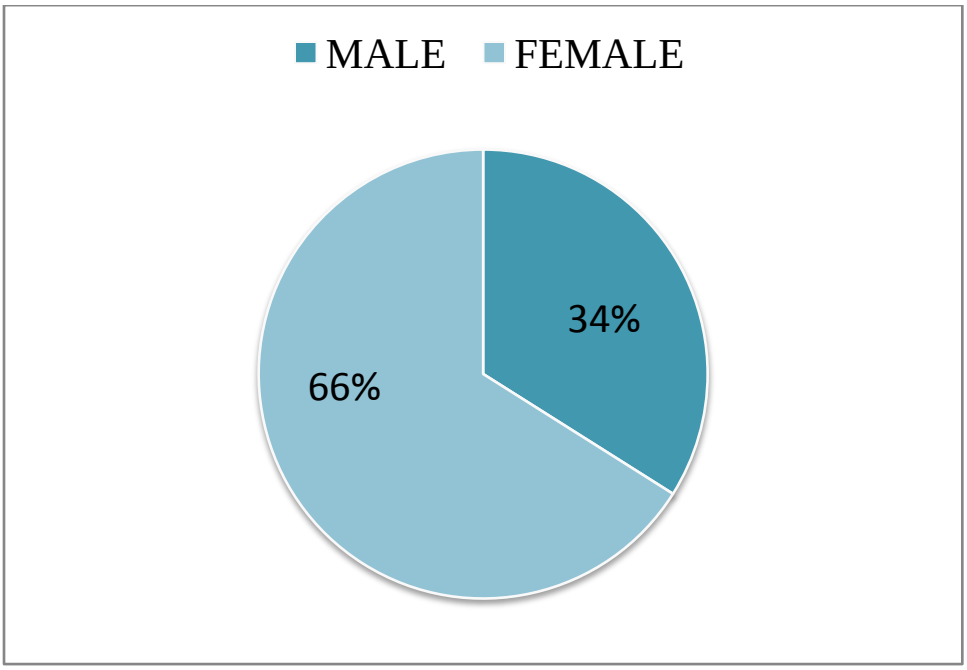


Table 6 shows that Subjects who volunteered for participation in the study group (breakfast skippers) were of 66% female and 34% male, but the difference was not statistically significant. Thus the number of female breakfast skippers was more in our study group than male breakfast skipper which is represented in the chart 2.

ANTHROPOMETRIC MEASUREMENTS

Chart 3 shows mean height of breakfast eaters being 164.06 was higher than the mean height of breakfast skippers 161.30. But the difference was not statistically significant as shown in table 7.

TABLE 7: HEIGHT

Group	Mean height(SD)	95% CI	p-value
Breakfast eaters	164.06(9.050)	-1.011 to 6.520	**0.150**
Breakfast skippers	161.30(10.449)		

CHART 3: COMPARISON OF HEIGHT BETWEEN TWO GROUPS

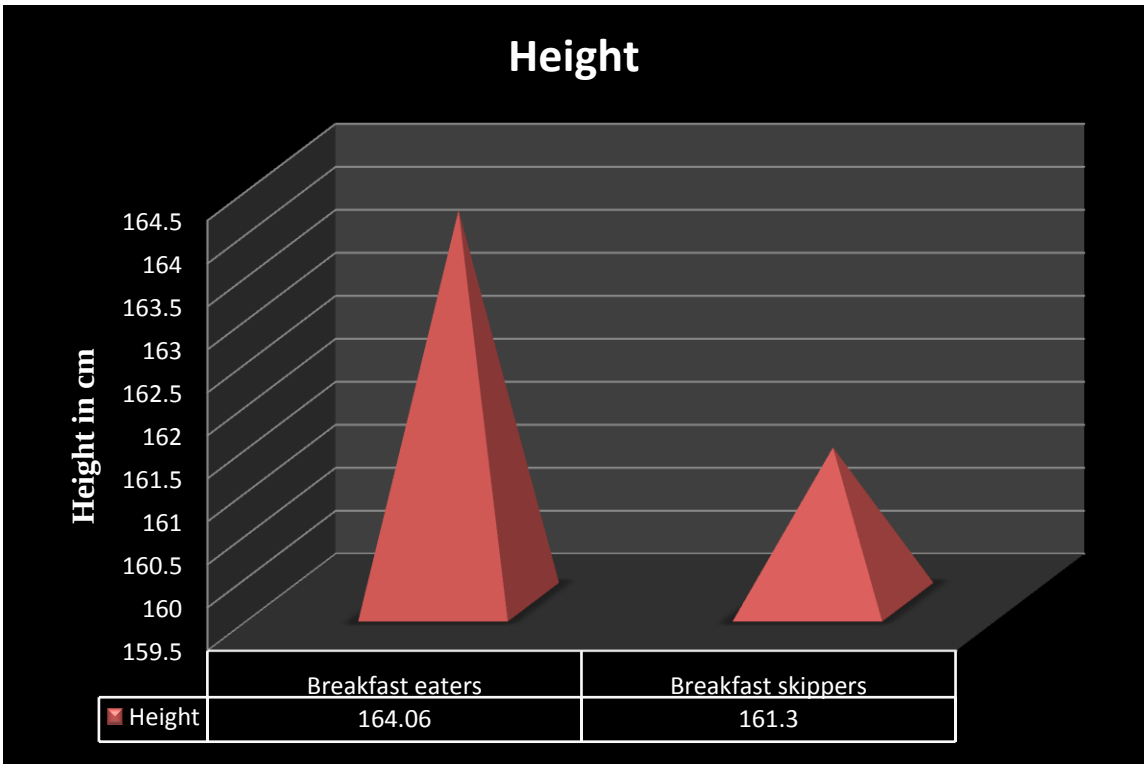


TABLE 8: WEIGHT

Group	Mean weight(SD)	95% CI	p-value
Breakfast eaters	67.298(16.1912)	5.3821 to 16.5915	**0.000***
Breakfast skippers	56.311(12.6970)		

Mean weight of breakfast eaters was 67.298 and mean weight of breakfast skipper was 56.311 and the difference in weight between the two group was statistically significant (0.000*) as shown in table 8 and chart 4.

CHART 4: COMPARISON OF WEIGHT BETWEEN TWO GROUPS

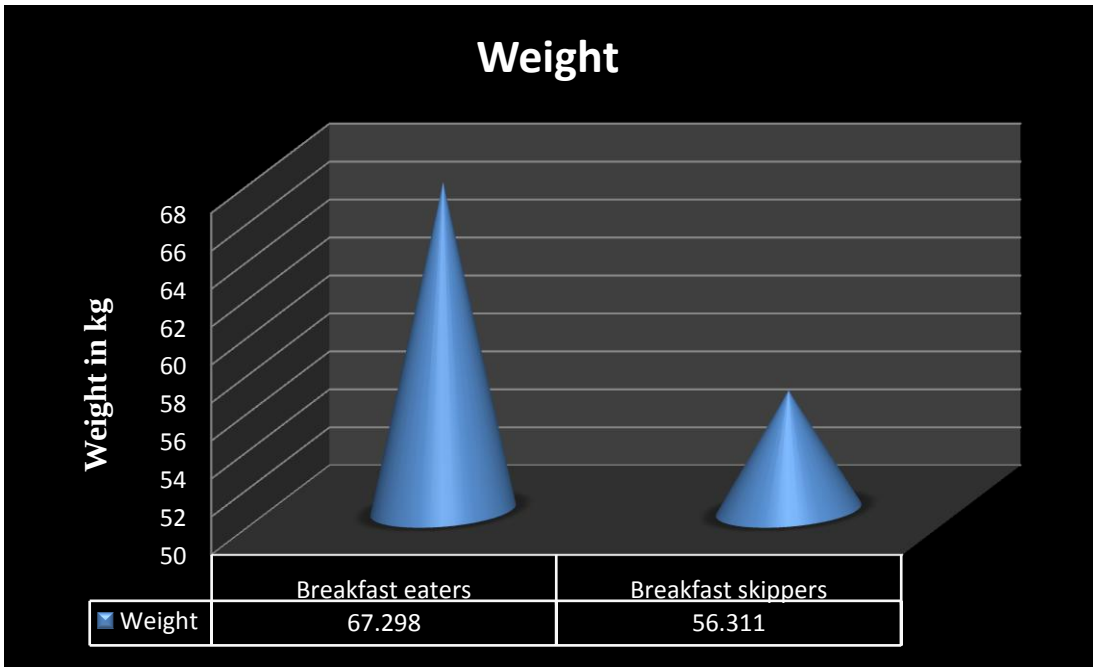
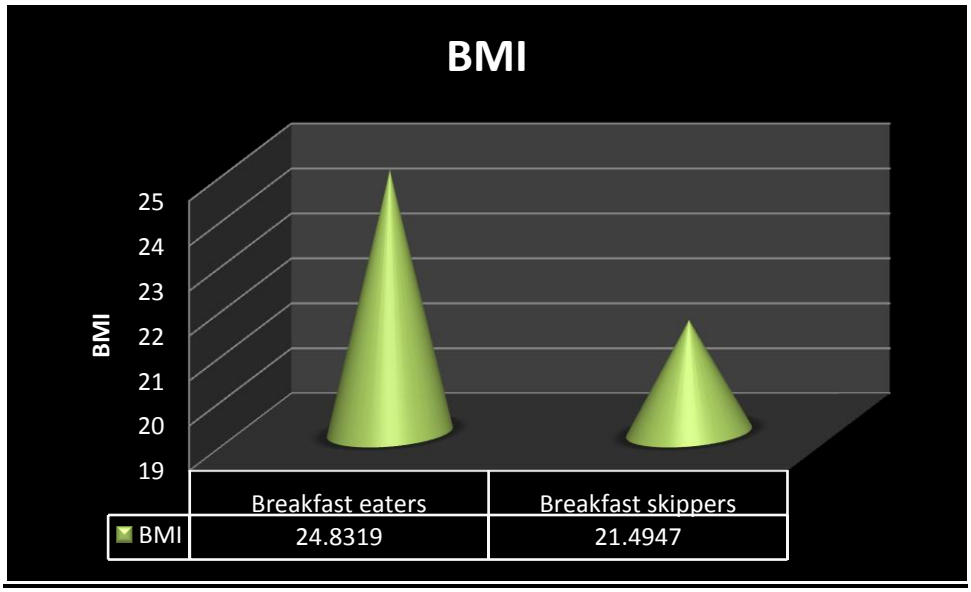


TABLE 9: BMI

Group	Mean BMI (SD)	95% CI	p-value
Breakfast eaters	24.8319(4.65704)	1.76746 to 4.90688	**0.000***
Breakfast skippers	21.4947(3.39422)		

CHART 5: COMPARISON OF BMI BETWEEN TWO GROUPS

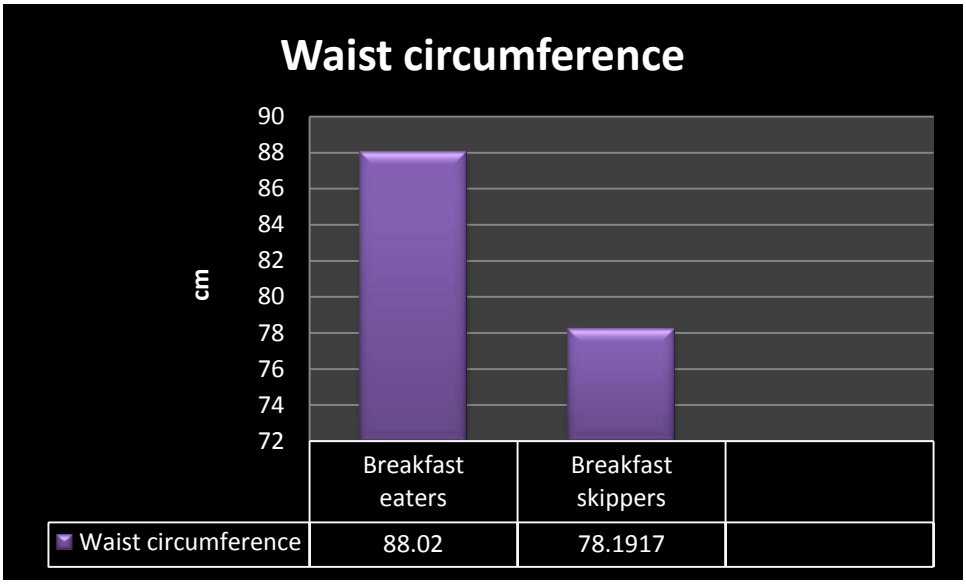


Breakfast eaters had mean BMI of 24.8 which is higher than the mean BMI of breakfast skipper (21.5) and the difference was statistically significant (0.000*) as shown in table 9 and chart 5.

TABLE 10: WAIST CIRCUMFERENCE

Group	Mean WC (SD)	95% CI	p-value
Breakfast eaters	88.02 (11.732)	5.30858 to 14.26341	**0.000***
Breakfast skippers	78.1917 (11.28806)		

CHART 6: COMPARISON OF WAIST CIRCUMFERENCE BETWEEN TWO GROUPS



Breakfast eaters had mean waist circumference of 87.9cm which is higher than the waist circumference of breakfast skipper (78.2cm) and the difference was statistically significant(0.000*) as shown in table 10 and chart 6

TABLE 11: HIP CIRCUMFERENCE

Group	Mean HC(SD)	95% CI	p-value
Breakfast eaters	100.17(12.097)	5.4034 to 14.5293	**0.000***
Breakfast skippers	90.149(11.3585)		

Breakfast eaters had mean hip circumference of 100.17cm which is higher than the hip circumference of breakfast skipper (90.14cm) and the difference was statistically significant (0.000*) as shown in table 11 and chart 7.

CHART 7: COMPARISON OF HIP CIRCUMFERENCE BETWEEN TWO GROUPS

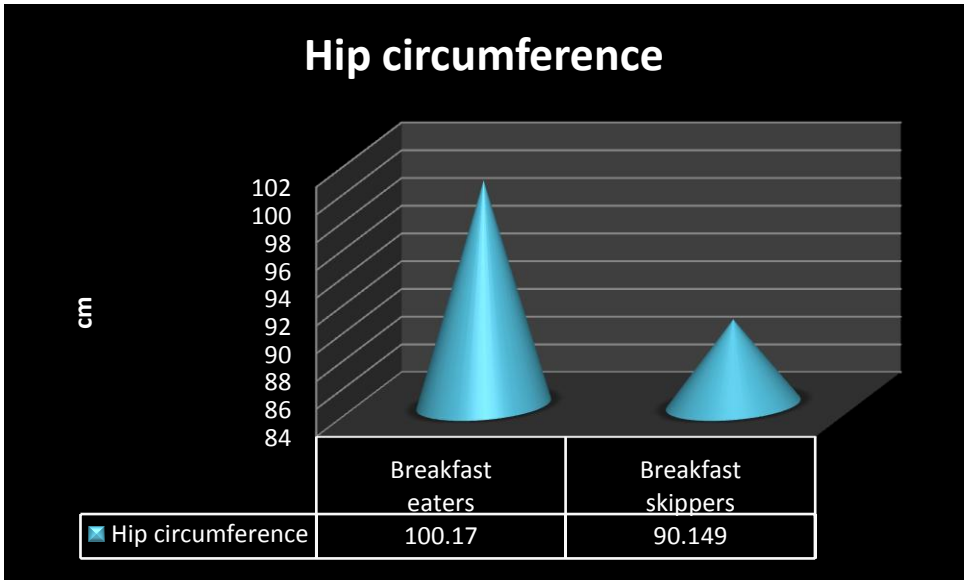
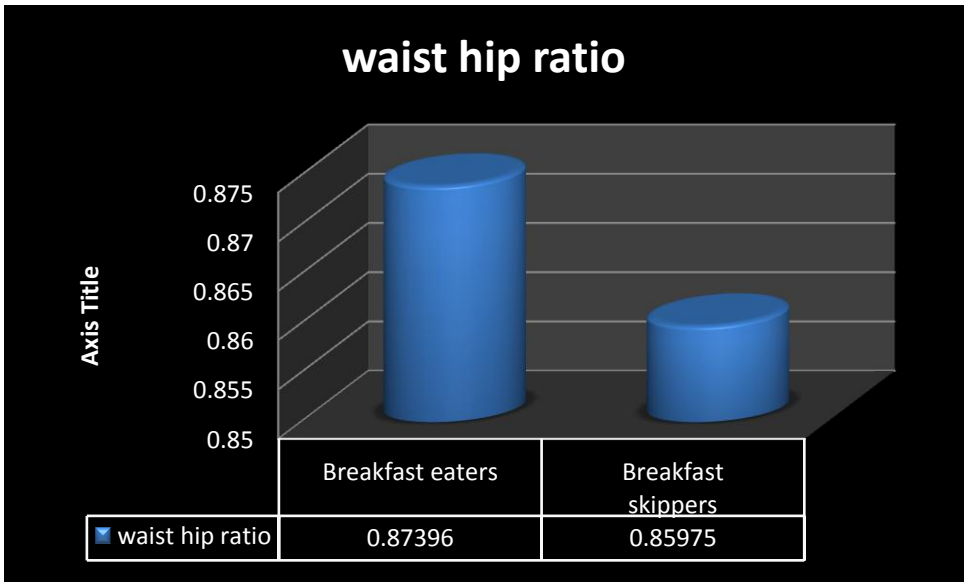


TABLE 12: WAIST HIP RATIO

Group	Mean WH Ratio (SD)	95% CI	p-value
Breakfast eaters	0.87396(0.070447)	-0.010279 to 0.038694	**0.253**
Breakfast skippers	0.85975(0.055941)		

CHART 8: COMPARISON OF WAIST HIP RATIO BETWEEN TWO GROUPS



Breakfast eaters had mean waist hip ratio of 0.87 which is greater than the waist hip ratio of breakfast skipper (0.86) but the difference was not statistically significant.

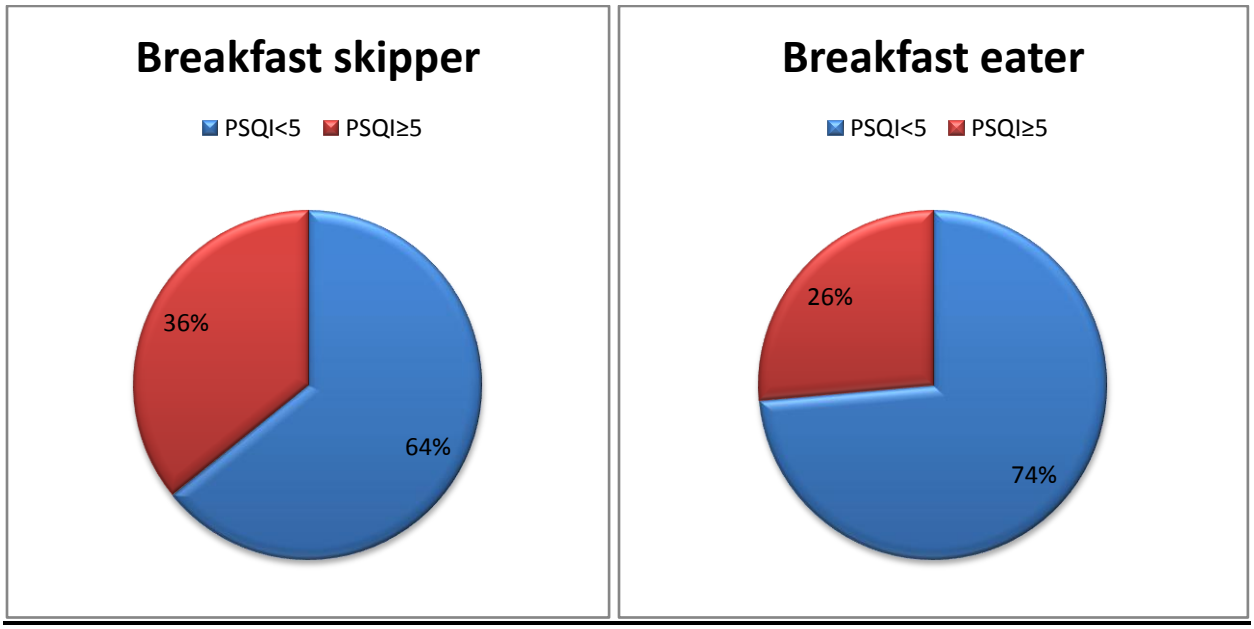
COMPARISON OF QUALITY AND PATTERN OF SLEEP

Subjective sleep quality was assessed by Pittsburgh sleep quality index. The frequency distribution of PSQI scores were as follows.

TABLE 13: FREQUENCY DISTRIBUTION OF PSQI SCORES

PSQI	No of breakfast eaters	No of Breakfast skippers
PSQI<5	39(73.6%)	34(64.2%)
PSQI≥5	14(26.4%)	19(35.8%)

CHART 9: DISTRIBUTION OF PARTICIPANTS BY PSQI SCORE IN BOTH GROUPS

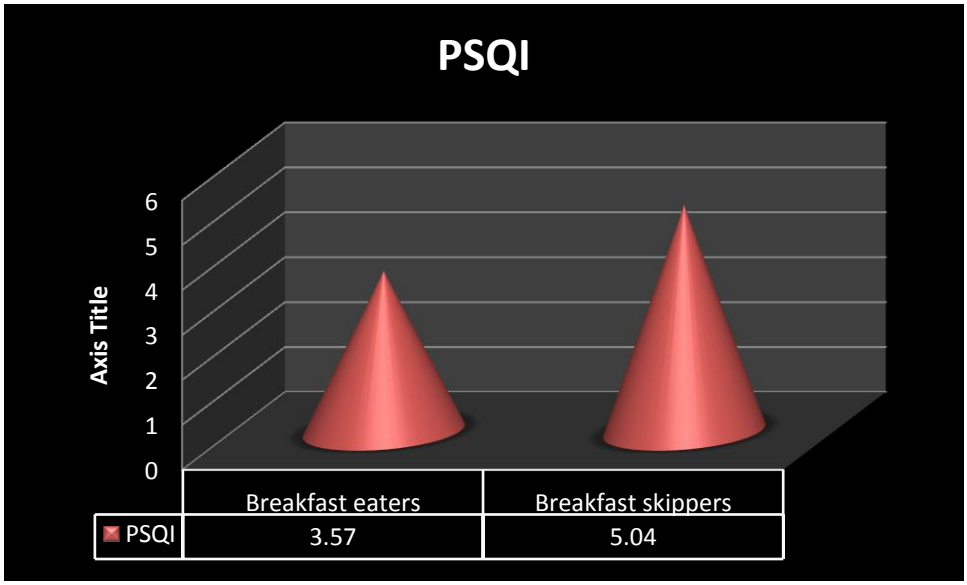


Out of 106 participants, those with PSQI score less than 5 were 39(73.6%) in breakfast eater group and 34(64.2%) in breakfast skipper group . Participants with PSQI score more than 5 were 14(26.4%) in breakfast eater group and 19(35.8%) in breakfast skipper group as shown in table 13 and chart 9.

TABLE 14: QUALITY AND PATTERN OF SLEEP

Group	Mean PSQI (SD)	95% CI	p-value
Breakfast eaters	3.57(2.422)	-2.598 to -0.345	**0.011***
Breakfast skippers	5.04(3.351)		

CHART 10: COMPARISON OF PSQI SCORE BETWEEN TWO GROUPS



Mean PSQI score of breakfast eaters were 3.57 whereas mean PSQI score of breakfast skippers were 5.04, which on comparison by an unpaired 't' test resulted in a 95% CI of -2.598 to -0.345 and resulted in a statistically significant p-value of 0.01 as shown in table 14 and chart 10.Thus it denotes that breakfast skippers had significantly poor quality of sleep when compared to the breakfast eaters.

COMPARISON OF COGNITIVE ABILITIES

The tests used for testing cognitive functions were

- Trial making task A
- Trial making task B
- Letter cancellation task
- Pair cancellation task
- Digit span task
- Mental arithmetic task

TRIAL MAKING TASK A & B:

TABLE 15: TRIAL MAKING TASK-A

Table 15 shows mean time taken (sec) for trial making task A by breakfast eater was 31.226 and by breakfast skipper was 33.991 which on comparison by unpaired 't'

Group	Mean TM-A score(SD)	95% CI	p-value
Breakfast eaters	31.226(9.1895)	-6.8731 to 1.3448	**0.185**
Breakfast skippers	33.991(11.9625)		

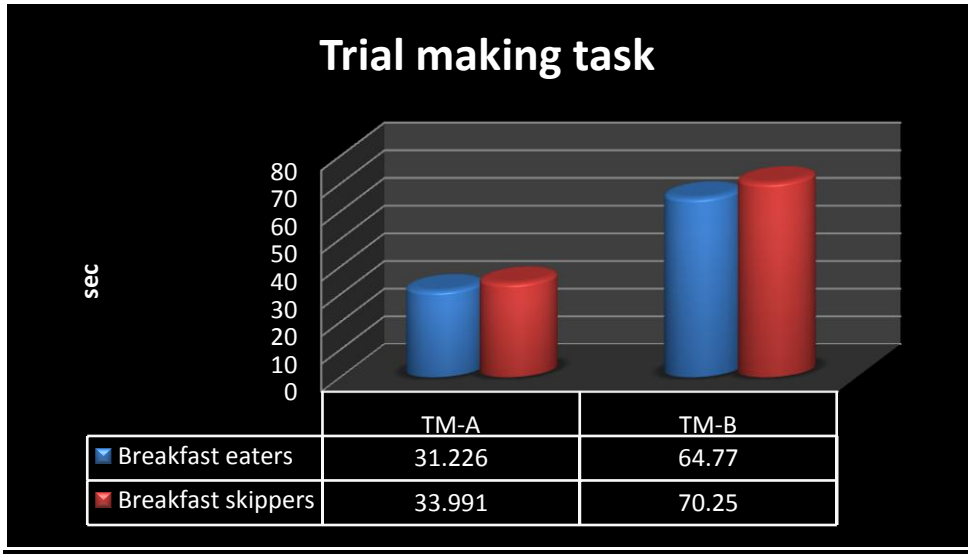
test resulted in a confidence interval of -6.8731 to 1.3448.

TABLE 16: TRIAL MAKING TASK-B

Group	Mean TM-B score (SD)	95% CI	p-value
Breakfast eaters	64.77(18.220)	-13.175 to 2.231	**0.162**
Breakfast skippers	70.25(21.628)		

Table 16 shows mean time taken (sec) for trial making task B by breakfast eater was 64.77 and by breakfast skipper was 70.25 which on comparison by unpaired 't' test resulted in a confidence interval of -13.175 to 2.231.

CHART 11: COMPARISON OF TRIAL MAKING SCORE BETWEEN TWO GROUPS

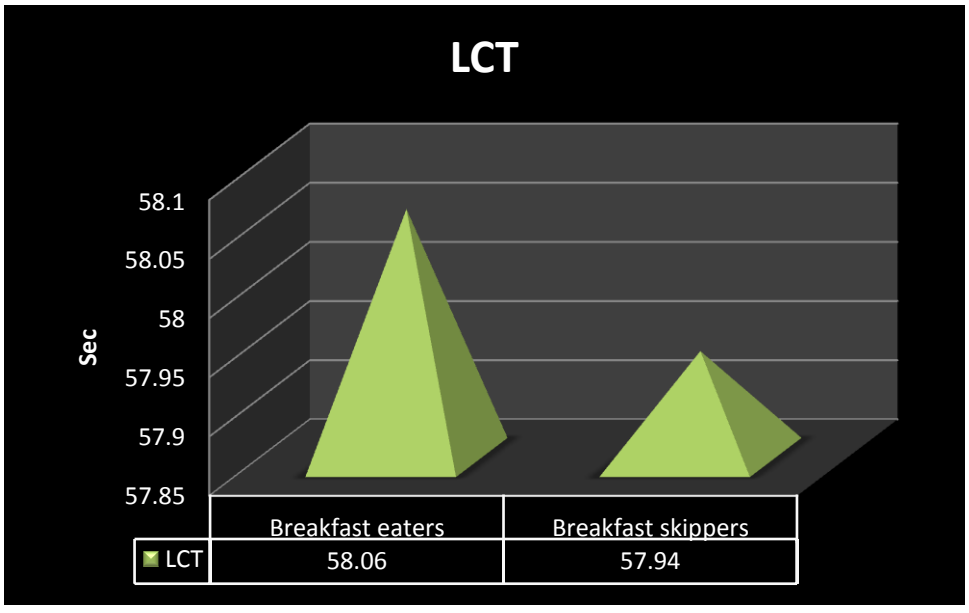


Thus the time taken for trial making task A &B in breakfast eaters was less than the time taken by breakfast skippers, but the difference in time taken for TM-B & TM-B between two groups was not statistically significant which is represented in the chart 11.

TABLE 17: LETTER CANCELLATION TASK

Group	Mean LCT score (SD)	95% CI	p-value
Breakfast eaters	58.06(10.987)	-5.014 to 5.240	**0.965**
Breakfast skippers	57.94(15.284)		

CHART 12: COMPARISON OF LETTER CANCELLATION TASK SCORE

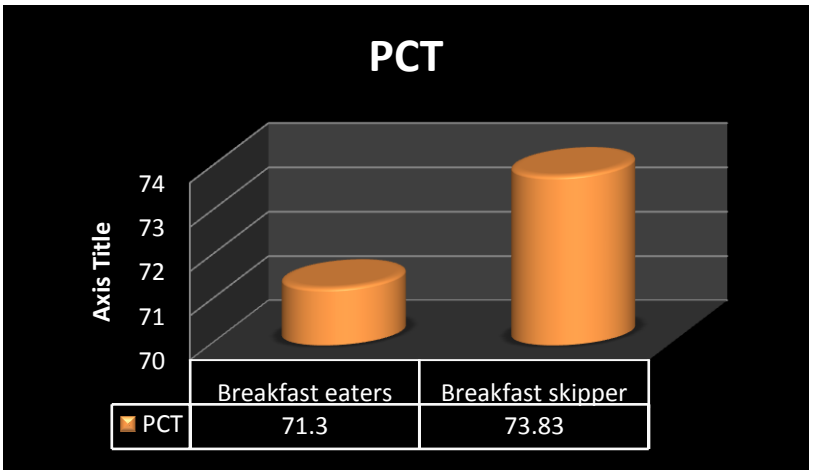


Mean time taken (sec) for letter cancellation task by breakfast eater was 58.06 and by breakfast skipper was 57.94, which on comparison by unpaired 't' test resulted in a confidence interval of-5.014 to 5.240. Thus time taken by breakfast eaters to complete LCT was greater than that in the breakfast skipper, but the difference in time taken for LCT between two groups was not statistically significant as shown in table 17 and chart 12.

TABLE 18: PAIR CANCELLATION TASK

Group	Mean PCT score(SD)	95% CI	P-value
Breakfast eaters	71.30(14.143)	-8.416 to 3.360	**0.396**
Breakfast skipper	73.83(16.347)		

CHART 13: COMPARISON OF PAIR CANCELLATION TASK SCORE



Mean time taken (sec) for pair cancellation task by breakfast eater was 71.3 and by breakfast skipper was 73.83, which on comparison by unpaired ‘t’ test resulted in a confidence interval of -8.416 to3.360. Thus time taken by breakfast eaters to complete PCT was less than that in the breakfast skipper, but the difference in time taken for PCT between two groups was not statistically significant as shown in table 18 and chart 13.

TABLE 19: MENTAL ARITHMETIC TASK

Group	Mean MAT score(SD)	95% CI	P-value
Breakfast eaters	19.353(13.7437)	-5.2547 to 3.2056	**0.632**
Breakfast skipper	20.377(7.2303)		

Mean time taken (sec) for mental arithmetic task by breakfast eater was 19.353 and by breakfast skipper was 20.377, which on comparison by unpaired ‘t’ test resulted in a confidence interval of -5.2547 to 3.2056. Thus time taken by breakfast eaters to complete MAT was less than that in the breakfast skipper, but the difference in time taken for MAT between two groups was not statistically significant as shown in table 19 and chart 14.

CHART 14: COMPARISON OF MENTAL ARITHMETIC TASK SCORE

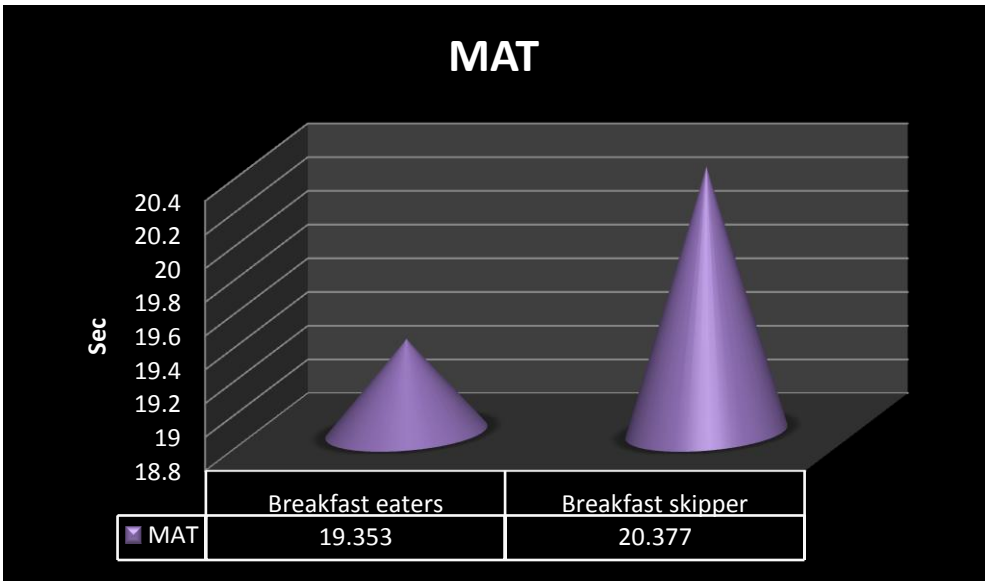


TABLE 20: DIGIT SPAN TASK

Group	Mean DST score(SD)	95% CI	P-value
Breakfast eaters	12.72(2.125)	0.396 to 2.203	**0.005***
Breakfast skipper	11.42(2.560)		

Mean score of digit span task by breakfast eater was 12.72 and by breakfast skipper was 11.42 , which on comparison by unpaired 't' test resulted in a confidence interval of 0.396 to 2.203. Thus score of MAT in breakfast eaters was more than that in

the breakfast skipper, and the difference was statistically significant (0.005*) as shown in table 20 and chart 15.

CHART 15: COMPARISON OF DIGIT SPAN TASK SCORE

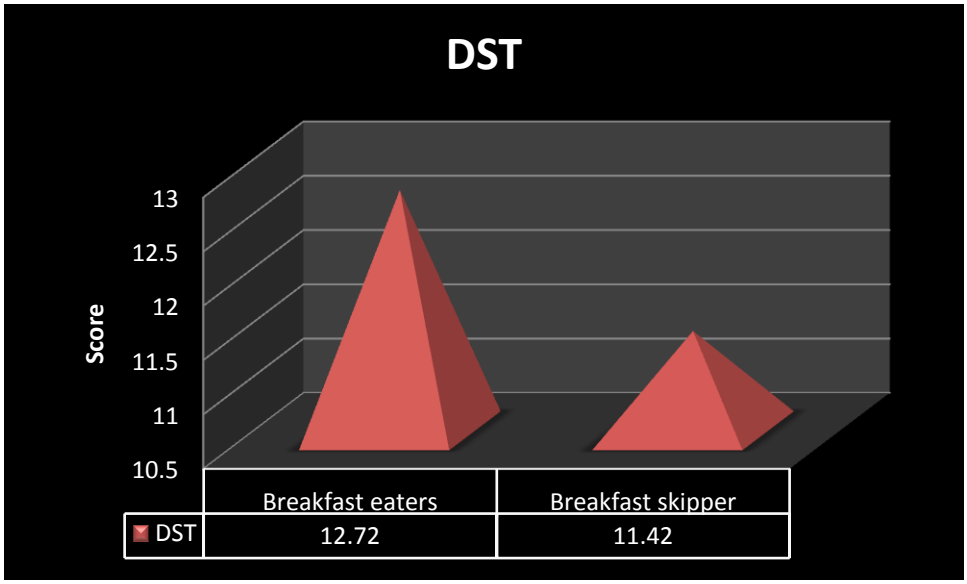


TABLE 21: STROOP TASK (RCNb)

Group	Mean RCNb score (SD)	95% CI	P-value
Breakfast eaters	58.75(15.763)	-5.855 to 8.421	**0.722**
Breakfast skipper	57.47(20.933)		

Table 21 shows mean time taken (sec) to complete RCNb (neutral) by breakfast eaters was 58.75 and by breakfast skipper was 57.47, which on comparison by unpaired 't' test resulted in a confidence interval of -5.855 to 8.421 . Thus time taken by breakfast eaters to complete RCNb was more than that in the breakfast skipper, but the difference in time taken between two groups was not statistically significant

TABLE 22: STROOP TASK (RCNc)

Group	Mean RCNc score (SD)	95% CI	P-value
Breakfast eaters	35.42(11.901)	-5.245 to 3.471	**0.687**
Breakfast skipper	36.30(10.693)		

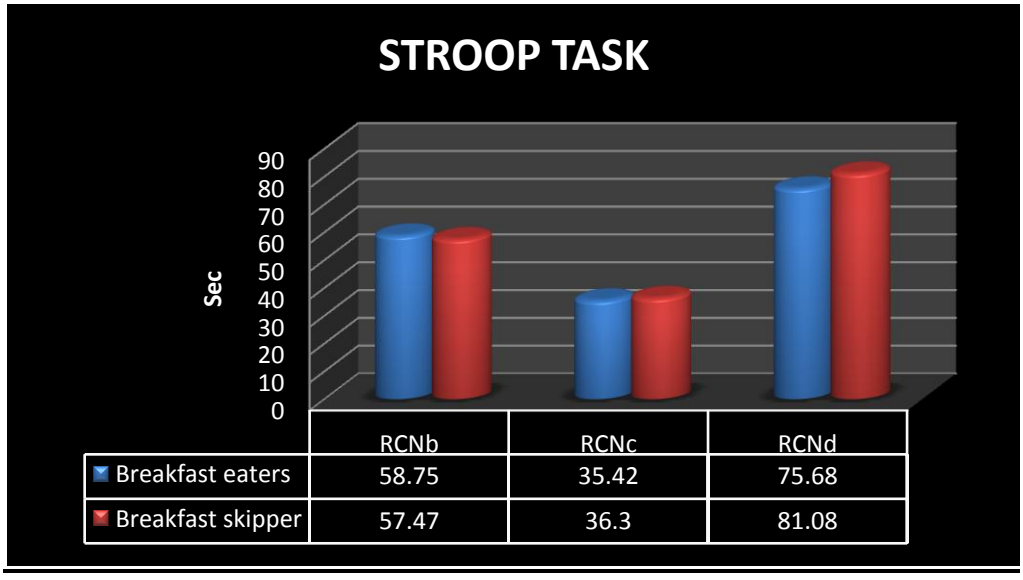
Table 22 shows mean time taken (sec) to complete RCNc (congruent) by breakfast eaters was 35.42 and by breakfast skipper was 36.30, which on comparison by unpaired 't' test resulted in a confidence interval of -5.245 to 3.471. Thus time taken by breakfast eaters to complete RCNc was less than that in the breakfast skipper, but the difference in time taken between two groups was not statistically significant.

TABLE 23: STROOP TASK (RCNd)

Group	Mean RCNd score(SD)	95% CI	P-value
Breakfast eaters	75.68(21.770)	-14.023 to 3.231	**0.218**
Breakfast skipper	81.08(23.002)		

Table 23 shows mean time taken (sec) to complete RCNc (incongruent) by breakfast eaters was 75.68 and by breakfast skipper was 81.08, which on comparison by unpaired 't' test resulted in a confidence interval of-14.023 to 3.231. Thus time taken by breakfast eaters to complete RCNd was less than that in the breakfast skipper, but the difference in time taken between two groups was not statistically significant.

CHART 16: COMPARISON OF STROOP TASK SCORE IN BOTH GROUPS



COMPARISON OF BLOOD GLUCOSE

TABLE 24: FASTING PLASMA GLUCOSE

Group	Mean FPG (SD)	95% CI	P-value
Breakfast eaters	87.85(30.163)	-2.895 to 15.914	**0.173**
Breakfast skipper	81.34(16.803)		

Mean fasting blood glucose of breakfast eaters was 87.85 and in breakfast skippers was 81.34, which on comparison by an unpaired 't' test resulted in a confidence interval of -2.895 to 15.914. Thus mean FBG in breakfast eaters was higher than that in the breakfast skipper, but the difference in FBG between two groups was not statistically significant as shown in table 24 and chart 17.

CHART 17: COMPARISON OF FASTING BLOOD GLUCOSE IN BOTH GROUPS

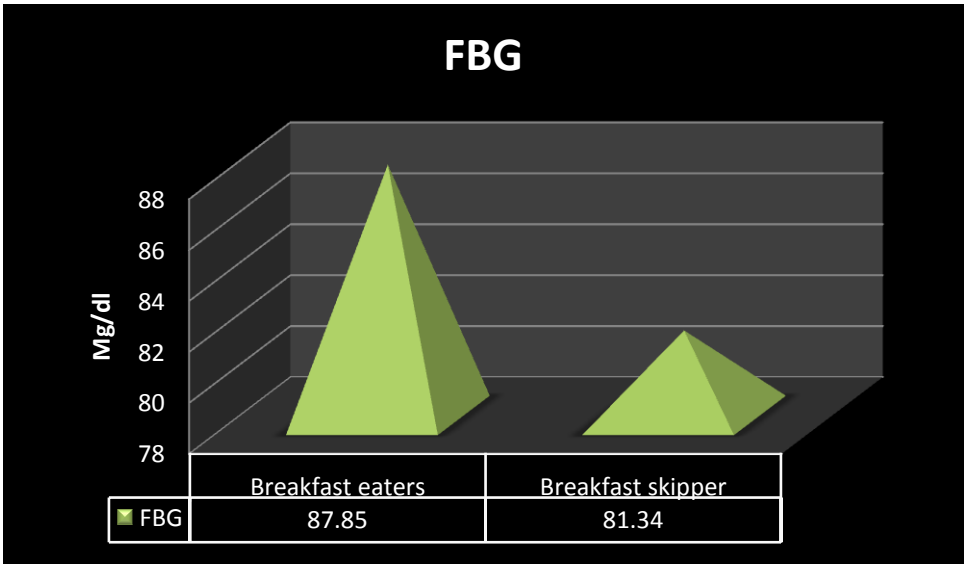
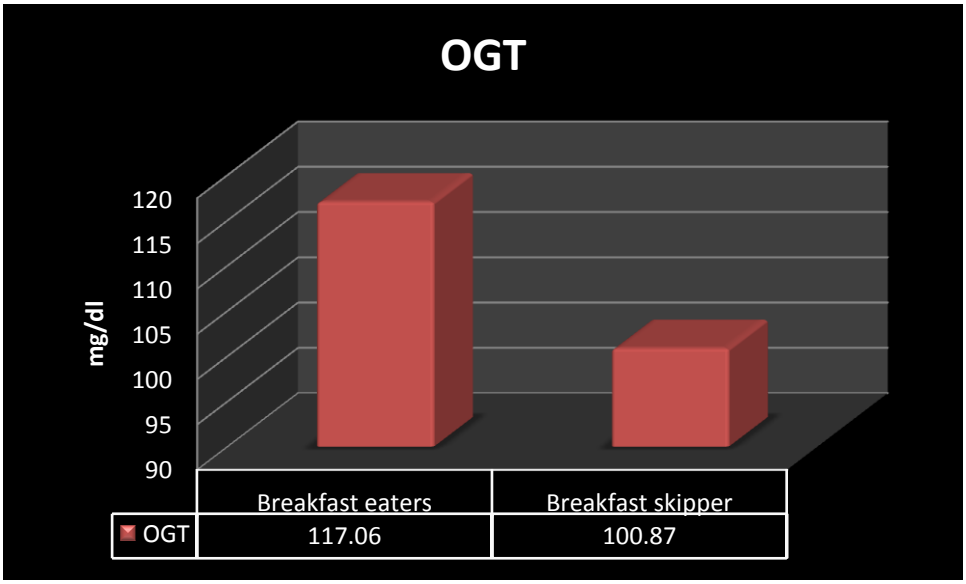


TABLE 25: ORAL GLUCOSE TOLERANCE TEST

Group	Mean OGT (SD)	95% CI	P-value
Breakfast eaters	117.06(49.681)	1.644 to 30.733	**0.029***
Breakfast skipper	100.87(19.567)		

Mean blood glucose 2 hr after 75 gm glucose load in breakfast eaters was 117.06 and in breakfast skippers was 100.87, which on comparison by an unpaired 't' test resulted in a confidence interval of 1.644 to 30.733. Thus mean OGT value in breakfast eaters was higher than that in the breakfast skipper, and the difference between two groups was statistically significant (0.029*) as shown in table 25 and chart 18.

CHART 18: COMPARISON OF OGT IN BOTH GROUPS



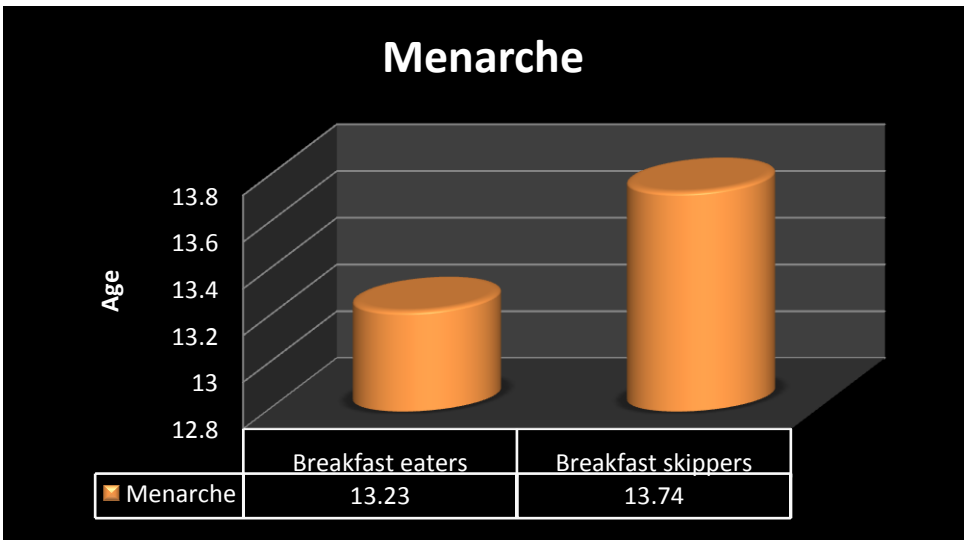
AGE AT MENARCHE

TABLE 26: AGE AT MENARCHE

Menarche	Mean (SD)	95% CI	p-value
Breakfast eaters	13.23(1.060)	-1.112 to 0.084	**0.091**
Breakfast skippers	13.74(1.421)		

Mean age at menarche in breakfast eaters was 13.23 and in breakfast skippers was 13.74, which on comparison by an unpaired 't' test resulted in a confidence interval of -1.112 to 0.084. Thus mean age at menarche in breakfast eaters was somewhat less than that in the breakfast skipper, but the difference between two groups was not statistically significant as shown in chart 19 and table 26.

CHART 19: COMPARISON OF AGE AT MENARCHE IN BOTH GROUPS



CORRELATION OF BMI AND BLOOD GLUCOSE LEVEL

TABLE 27: BMI AND BLOOD GLUCOSE LEVEL

BMI	B-Eater (n=53)		Correlation value	Statistical inference
		OGT	.136	.330>0.05 NS
		FBG	.105	.456>0.05 NS
	B-Skipper (n=53)		Correlation value	Statistical inference
		OGT	.093	.509>0.05 NS
		FBG	-.060	.671>0.05 NS

No significant correlation was observed between the BMI and blood glucose level (FBG&OGT) as shown in table 27.

CORRELATION OF SLEEP QUALITY AND BLOOD GLUCOSE LEVEL

TABLE 28: PSQI AND BLOOD GLUCOSE LEVEL

PSQI	C B-Eater with PSQI more than 5		Correlation value	Statistical inference
		OGT	-.153	.275>0.05 NS
			Correlation value	Statistical inference
		FBG	-.061	.662>0.05 NS
PSQI	B-Skipper with PSQI more than 5		Correlation value	Statistical inference
		OGT	-.136	.332>0.05 NS
			Correlation value	Statistical inference
		FBG	**-.325(*)**	.018<0.05 S

In breakfast skippers, fasting blood glucose value was negatively correlated with PSQI and it was statistically significant (.018) as shown in table 28.

CORRELATION OF BLOOD GLUCOSE LEVEL WITH DIGIT SPAN TASK PERFORMANCE

TABLE 29: DST AND BLOOD GLUCOSE LEVEL

B-Eater (n=53) DST		Correlation value	Statistical inference
	FBG	-.049	.728>0.05 NS
		Correlation value	Statistical inference
	OGT	.020	.888>0.05 NS
B-Skipper (n=53) DST		Correlation value	Statistical inference
	FBG	**-.550(**)**	.000<0.01 S
		Correlation value	Statistical inference
	OGT	**-.454(**)**	.001<0.01 S

In breakfast skippers, fasting plasma glucose and OGT were negatively correlated with digit span task performance and it was statistically significant as shown in table 29.

CORRELATION OF SLEEP QUALITY WITH DIGIT SPAN TASK PERFORMANCE

TABLE 30: DST AND PSQI

B-Eater with PSQI more than 5	Correlation value	Statistical inference
	.133	.344>0.05 NS
B-Skipper with PSQI more than 5	Correlation value	Statistical inference
	.348(*)	.011<0.05 S

In breakfast skippers, sleep disturbance was positively correlated with digit span task performance and it was statistically significant (.011) as shown in table 30.

DISCUSSION

There is inconclusiveness in the definition for the term **'Breakfast'** in the previous literatures. **Preziosi et al** defined breakfast as consumption of solid food or beverage for the first occasion that occurred soon after waking from overnight sleep, [18] **Yang et al** defined breakfast as the food that is taken before 09.00 hours irrespective of content of the meal. [77]**Timlin and Pereira** defined it as: the first meal of the day that is eaten before or at the start of the daily activities within 2 h of waking, and typically not later than 10.00 a.m in the morning and of a caloric value between 20–35% of the daily energy needs.[1]Breakfast in our study refers to the definition that was designed by **Timilin et al** which is broadly used for research purposes.

GENDER DIFFERENCES IN BREAKFAST HABITS

In our study, randomly recruited breakfast skipping subjects consisted of more number of breakfast skipping women (66.04%) than the breakfast skipping men (33.96%). Many previous studies revealed gender-specific differences in breakfast eating patterns.[19,78,79] Our findings supports the previous finding that women skips breakfast more commonly than men. More prevalence of skipping breakfast habit among girls is probably because of common misconception, that it helps in reducing body weight.[15] It

implies that there should be a stronger focus on females to encourage better breakfast habits.

RELATION BETWEEN BREAKFAST HABITS AND ANTHROPOMETRIC MEASURES

Mean height of subjects who eat regularly is more than the mean height of subjects who has breakfast skipping habit but the difference was not statistically significant. It is further supported by a study conducted by C A Powell et al. He found that height in children improved significantly (0.25 cm) after providing breakfast for 1year. Thus it denotes breakfast has benefits of improving nutritional status.[80]

In our analysis it has been found that the subjects who eat breakfast regularly had high BMI, waist circumference and hip circumference when compared to the subjects who skip breakfast for more than 3 days a week. This is in contradiction to the study by Stalo papoutsou et al who showed inverse relation between regular breakfast habit and BMI. Girls who consumed breakfast daily had lower mean BMI compared to girls with irregular breakfast habit. [26]

Nafis et al studied breakfast skipping and its effects on development of obesity and found that obesity and overweight was more prevalent among persons who had irregular breakfast habits. This finding is not in correlation with our results.[31]

A systemic review of 16 studies was done by Hania Szajewska et al to study the association between breakfast habits and its influence on body weight. Thirteen out of

sixteen studies showed that breakfast consumption prevents obesity. One out of sixteen study showed that this positive effect of breakfast on body weight maintenance was only among male.[81] The physiological mechanisms that were proposed to contribute to this effect of breakfast habit on body weight was appetite control by means of increased satiety and blood sugar control.[82]

Additionally, it has been found in a study by Hanna Isaksson that small changes in composition of diet have the potential to affect feelings of hunger and satiety and ultimately body weight. He has demonstrated satiety enhancing effect of whole grain rye foods, breads as well as porridges, compared to an iso-caloric shifted wheat bread. It implies that satiety depends upon the type of food consumed.[83]

Alexandra Veltsista et al in his study on association between breakfast eating behavior and overweight/obesity among Greek and Finnish adolescents found that breakfast consumption was associated with decreased level of obesity/overweight. But these effects were found only among boys and not among girls.[30] This shows that there is a gender specific difference in the breakfast's effect on body weight.

Since our study consists of more number of females, the effect of breakfast consumption behavior on BMI was not pronounced which is supported by the previous studies. It has been shown that these effects depend upon the type of food consumed. Reason for contradictory results may be due to lack of information about composition of food.

Though BMI, Waist circumference, hip circumference were higher among breakfast eaters, waist hip ratio which is an important marker of adiposity was more among breakfast eaters than breakfast skippers in our study but it was not statistically significant.

Our study concludes that breakfast eaters has increased tendency for adiposity when compared to the breakfast skipper.

EFEECTS OF BREAKFAST HABITS ON SLEEP

In our study quality and pattern of sleep as assessed by The Pittsburgh Sleep Quality Index (PSQI) shows that the mean PSQI score in breakfast skipper (5.04) was more than the mean PSQI score in breakfast eaters (3.57) and the difference was statistically significant. This denotes that the breakfast skippers have poor quality of sleep when compared to the breakfast eaters.

Our study findings can be substantiated by the study conducted by Juan Sun who showed significant association between regular breakfast consumption and better sleep quality. The physiological mechanism underlying these effects were thought to be that the breakfast containing adequate tryptophan gets metabolized into serotonin which is a potent antidepressant and it promotes morning type diurnal rhythm. At night, serotonin is converted into melatonin in the pineal gland which is a sleep inducer. Thus it helps in good quality of sleep at night.[61,84 ,85] Circadian rhythm is mainly affected by metabolism

and food intake. Breakfast skipping habits in turn lead to alteration in the circadian rythmicity.[86]

Our results were in consistent with the previous study by Lan wang et al who found a definite association between breakfast skipping habit and poor quality of sleep.[62]

Midori nishiyama et al investigated the unhealthy behaviors associated with breakfast skipping habit and found that persons who skip breakfast had poor quality of sleep.[45] These evidences support our study.

The observation in our study is further supported by a study by Cheng et al who used the same PSQI scale we have used. They observed that poor sleep quality was significantly correlated with breakfast skipping habit.[60]

COGNITION

We found that

- Breakfast eaters scored significantly higher than breakfast skippers in digit span task.
- Performance of breakfast eaters in trial making task A & B, pair cancellation task, mental arithmetic task was better than the performance of breakfast skippers. But the difference in performance was not statistically significant.

- Breakfast eater's performance in letter cancellation task was less than the performance of breakfast skippers.
- In stroop task, breakfast eaters performed well in congruent and incongruent stroop task than breakfast skipper but the difference was not statistically significant and breakfast eaters showed poor performance in neutral stroop task.

Thus our study showed that breakfast eaters had significantly enhanced working memory. They also had enhanced attention, concentration, special scanning ability, general sequence reasoning, mathematic fluency and processing speed even though it was not statistically significant. Perceptual speed was less in breakfast eaters compared to breakfast skipper.

Our results correlated with the findings of previous study by Michaud C et al who assessed 319 subjects and found that breakfast produces beneficial effect on immediate recall in short term memory but impairment of concentration.[44]

Our study is further supported by a study by Gajer et al who found out the beneficial influence of breakfast habit on attention-concentration, memory and school achievement.[54]

Tanya Zilberter et al observed that breakfast effects on cognition depends on composition of breakfast and glucose tolerance in adults.[55] Contradiction to our results, López I et al showed no influence of breakfast habit on cognition. These contradictory

results may be due to difference in breakfast composition and glucose tolerance of the study participants.[53]

Previous article state that breakfast by supplying blood sugar helps in the formation of neurotransmitter acetylcholine and dopamine. These neurotransmitters improve mental focus, memory and brain productivity. Thus breakfast consumption enhances memory, problem solving skill, focus and alertness which substantiates our findings.[15]

BREAKFAST AND GLUCOSE HOMEOSTASIS

Our study results showed that breakfast eaters had significantly higher mean value of plasma blood glucose 2 hr after 75gm load and also showed higher mean value of fasting plasma glucose level in breakfast eaters even though it was not statistically significant and was not in diabetic range.

Study by Michaud C et al showed that the breakfast habit does not produce any beneficial effects on blood glucose level which is consistent with our results.[44]

Most of the other studies are contradicting to our results, such as Midori nishyama et al showed that the combined habits of smoking and breakfast skipping increase the prevalence of type 2 Diabetes Mellitus.[45] Yulan li et al in his study found that breakfast skipping habit was associated with impaired fasting plasma glucose level.[43]

Study by Rania A Mekary et al showed that breakfast skipping habit was positively associated with increased risk of type 2 diabetes.[46] Fumi Kobayashi et al found that breakfast skipping habit increases the overall 24 hr average blood glucose level.[48] All the above contradicting results justifies the fact that breakfast by increasing satiety, and also by weight control reduces risk for Diabetes Mellitus. In our study we didn't find any significant differences in weight in breakfast skippers when compared to the breakfast eaters .Composition of breakfast consumed was also not assessed in our study which may be the reasons for contradicting result in our study.

BREAKFAST AND AGE AT MENARCHE

We found no significant difference in age at menarche between breakfast eaters and breakfast skippers in our study.

Conversely study by Jae-Seong Heo et al showed that 3% of girls with precocious puberty had irregular breakfast habits. He explained that having a good breakfast can reduce calorie intake and help with weight management. Thus by this mechanism regular breakfast consumption reduces the onset of precocious puberty.[87] In our study breakfast skipping subjects didn't have any significant differences in weight when compared to the breakfast eaters. That may be the reason why we didn't get any differences in pubertal age.

RELATIONSHIP BETWEEN BMI, SLEEP QUALITY, BLOOD GLUCOSE LEVEL, DIGIT SPAN TASK PERFORMANCE

BMI and blood glucose level after 2hr of 75gm glucose load (OGT) was positively correlated in both the group. Also there was a positive correlation between fasting blood glucose and BMI in breakfast eaters. But the correlation was not statistically significant. Our findings are supported by a study by Bakari AG et al who showed a positive but a non-significant association between BMI and blood glucose level among females and no association between BMI and blood glucose among males.[88] Since many of our study participants were females, we have got similar results.

Previous study conducted by Onyesom Innocentn et al found a weak positive correlation between BMI and blood glucose level among men and significant positive correlation between BMI and blood glucose level among women which further supports our study**.**[89] The relationship between BMI and blood glucose depends upon race and other biological factors.[90] Since the study by Onyesom Innocentn et al was found among Nigerians, racial factor may be responsible for the varying results.

In our study, it was observed that blood glucose level and sleep disturbance was negatively associated among both the group. There was a significant negative association between fasting blood glucose level and sleep disturbance in breakfast skippers. Our finding is supported by Christophe Varin et al who found that glucose concentration monitors the gating of K-ATP channels of sleep-promoting neurons present in the VLPO of hypothalamus and the excitability of these neurons depends upon

the extracellular glucose concentration.[91] Kristen L Knutson et al found that sleep disturbance leads to alteration in glucose metabolism which is consistent with our study.[92] Van Helder T also found that sleep deprivation leads to glucose intolerance, insulin insensitivity and ultimately insulin exhaustion.[93] All these studies infer that there is a definite relation between blood glucose and sleep disturbance.

To study the possible mechanism we have hypothesized for the relationship between cognition and blood glucose as given by previous studies, we examined the correlation between DST and blood glucose level. In breakfast skippers there was a significant negative correlation between digit span task performance and blood glucose levels (both FBG and OGT). These results imply that higher blood glucose level is associated with decline of cognitive performance. Our finding is supported by Moyra E. Mortby et al who found that higher blood sugar value results in cognitive decline.[94] Our finding is contradictory to the previous finding by David Benton et al who showed that breakfast consumption habit enhanced memory by increasing the blood glucose level. They have also explained other possible mechanisms for memory enhancing effects of breakfast like consumption of food resulting in release of gut peptides like cholecystokinin which has memory enhancing central action and also release of insulin which also can produce memory enhancing effects which may be the reason for our findings. [95]

We have observed significant positive association between sleep disturbance and digit span task performance in breakfast skippers, which implies that more the sleep

disturbance more will be the decline in cognitive performance. Paula Alhola et al explained that frontal lobe is vulnerable to both acute and chronic sleep deprivation .[96] Thus, sleep deprivation impairs attention and memory which supports our study. Our finding is further supported by the previous study by Gilbert et al who showed that poor sleep quality has negative impact on academic functioning in non-depressed students.[97]

SUMMARY

- Study was conducted among 106 participants (53 breakfast eaters and 53 skippers).
- Physiological parameters such as anthropometric measurements, sleep quality, cognition, blood glucose levels and age at menarche were compared between the two groups.
- Breakfast eaters had significantly higher BMI, waist circumference, hip circumference and waist hip ratio when compared to breakfast skippers.
- Breakfast eaters had significant better sleep quality when compared to the breakfast skippers.
- Breakfast eaters performed significantly well in digit span task when compared to the breakfast skippers.
- Breakfast eaters had higher blood glucose level (especially OGTT) when compared to the breakfast skippers
- Poor performance of breakfast skippers in digit span task was positively associated with sleep disturbance.
- Sleep disturbance was negatively associated with blood glucose level.(FBG)
- Digit span task performance in breakfast skipper was negatively associated with blood glucose level.

LIMITATIONS

- Breakfast consumption was self-reported and subjective interpretation which may result in information bias.
- There is no proper definition of breakfast in the previous literature which may be responsible for variations in results.
- Our study population consisted of unequal number of male and female which could have affected our results.
- Proper quantity, type and composition of breakfast were not recorded in our study which limits us to find the detailed cause of our findings.
- Pattern of sleep and sleep quality was assessed by a subjective questionnaire which may lead to recall bias.
- Cognition abilities were tested by using various cognitive tasks on single occasion at comfortable time which limits ability to find relation of food consumption and cognitive abilities.
- Since it was an observational study, we cannot determine the appropriate cause whether skipping breakfast was a result or a cause of the factors identified.

RECOMMENDATIONS

- In future studies detailed assessment of food intake by 24 hour recall or food-frequency questionnaires will help us to study relation between skipping breakfast and other physiological parameters.
- In future studies gender can be matched for better comparison.
- This study can be conducted with a larger sample size with wider age group for better results.
- Cognitive tasks can be carried out on multiple occasions at a particular time in all the contestants which could increase reliability.
- Detailed sleep study can be carried out to find out definitive role of breakfast on sleep habits in future studies.

BIBLIOGRAPHY

1. Timlin MT, Pereira MA. Breakfast frequency and quality in the etiology of adult obesity and chronic diseases. Nutr Rev. 2007;65:268–81

2. Yulan Li,Tohru Nemoto,Satoshi Tobimatsu,Masafumi Saito,Midori Ebata,Hiromi Munakata, Kei Nakajima, Relationship between skipping breakfast and impaired fasting glucose along with cardiovascular and pre-diabetes condition risk factors in apparently healthy subjects Endocrinology Studies 2011; volume 1:e17

3. De la Hunty A, Ashwell M. Are people who regularly eat breakfast cereals slimmer than those who don't? A systematic review of the evidence. Nutrition Bulletin. 2007 Jun 1;32(2):118-28.

4. Ruxton CH, Kirk TR. Breakfast: a review of associations with measures of dietary intake, physiology and biochemistry. British Journal of Nutrition. 1997 Aug 1;78(02):199-213.

5. Siega-Riz AM, Popkin BM, Carson T. Trends in breakfast consumption for children in the United States from 1965-1991. Am J Clin Nutr 1998;67:748S–56S

6. Haines PS, Guilkey DK, POPKIN B. Trends in breakfast consumption if US adults between 1965 and 1991. Journal of the American Dietetic Association. 1996 May 31;96(5):464-70.

7. Odegaard AO, Jacobs DR, Steffen LM, Van Horn L, Ludwig DS, Pereira MA. Breakfast frequency and development of metabolic risk. Diabetes care. 2013 Oct 1;36(10):3100-6

8. Kobayashi F, Ogata H, Omi N, Nagasaka S, Yamaguchi S, Hibi M, Tokuyama K. Effect of breakfast skipping on diurnal variation of energy metabolism and blood glucose. Obesity research & clinical practice. 2014 Jun 30;8(3):e249-57.

9. Alexa Hoyland, Louise Dye* and Clare L. Lawton A systematic review of the effect of breakfast on the cognitive performance of children and adolescents Nutrition Research Reviews (2009), 22, 220–243

10. Rampersaud G, Pereira M, Girard B, Adams J, Metzl J: Breakfast habits,nutritional status, body weight and academic performance in children and adolescents. J Am Diet Assoc 2005, 105:743–760

11. Harada T, Hirotani M, Maeda M, Nomura H, Takeuchi H: Correlation between Breakfast tryptophan Content and Morningness-Eveningness in Japanese Infants and Students Aged 0–15 yrs. J Physiol Anthropol 2007,26(2):201–208.

12. Nakade M, Akimitsu O, Wada K, Krejci M, Noji T, Taniwaki N, Takeuchi H,Harada T: Can breakfast tryptophan and vitamin B6 intake and morning exposure to sunlight promote morning-typology in young children aged 2 to 6 years? J Physiol Anthropol 2012, 31(1):11.

13. Wang L, Qin P, Zhao Y, Duan S, Zhang Q, Liu Y, Hu Y, Sun J. 9572Prevalence and risk factors of poor sleep quality among Inner Mongolia Medical University students: a cross-sectional survey. Psychiatry Research. 2016 Jul 19.

14. Spence C. Breakfast: The most important meal of the day?. International Journal of Gastronomy and Food Science. 2017 Jan 31.

15. Pal GK. A good breakfast is good for health. International Journal of Clinical and Experimental Physiology. 2016 Jan 1;3(1):1.

16. Vingerhoeds MH. Breakfast benefits for children and adolescents. Wageningen UR; 2015.

17. Schoenborn CA. Health habits of US adults, 1985: the" Alameda 7" revisited. Public Health Reports. 1986 Nov;101(6):571

18. Sivaramakrishnan M, Kamath V. A typical working-day breakfast among children, adolescents and adults belonging to the middle and upper socio-economic classes in Mumbai, India–challenges and implications for dietary change. Public health nutrition. 2012 Nov 1;15(11):2040-6.

19. Sajjad A, Anwer M, Anwer S, Zaidi SA, Hasan A. Missing breakfast, sleep and exercise: are you skipping out years of life. Journal of Nutrition and Health Sciences. 2014 Nov 7;1(3):1.

20. Sirichakwal PP, Janesiripanich N, Kunapun P, Senaprom S, Purttipornthanee S. Breakfast consumption behaviors of elementary school children in Bangkok Metropolitan Region. Southeast Asian J Trop Med Public Health 2015;46:939‑48.

21. Sampson AE, Dixit S, Meyers AF, Houser R Jr. The nutritional impact of breakfast consumption on the diets of inner-city African-American elementary school children. J Natl Med Assoc. 1995;87:195-202

22. Nicklas TA, Bao W, Webber LS, Berenson GS. Breakfast consumption affects adequacy of total daily intake in children. J Am Diet Assoc. 1993;93: 886-891.

23. Garg M, Rajesh V, Kumar P. Effect of breakfast skipping on nutritional status and school performance of 10-16 years old children of udupi district. Health and Population-Perspectives and Issues. 2014;37(3):98-117.

24. Gonzalez JT, Veasey RC, Rumbold PL, Stevenson EJ. Breakfast and exercise contingently affect postprandial metabolism and energy balance in physically active males. British Journal of Nutrition. 2013 Aug;110(4):721-32.

25. Betts JA, Richardson JD, Chowdhury EA, Holman GD, Tsintzas K, Thompson D. The causal role of breakfast in energy balance and health: a randomized controlled trial in lean adults. The American journal of clinical nutrition. 2014 Aug 1;100(2):539-47.

26. Papoutsou S, Briassoulis G, Hadjigeorgiou C, Savva SC, Solea T, Hebestreit A, *et al.* The combination of daily breakfast consumption and optimal breakfast choices in childhood is an important public health message. Int J Food Sci Nutr 2014;65:273‐9.

27. Alexander KE, Ventura EE, Spruijt-Metz D, Weigensberg MJ, Goran MI, Davis JN. Association of breakfast skipping with visceral fat and insulin indices in overweight Latino youth. Obesity. 2009 Aug 1;17(8):1528-33.

28. Maddah M, Rashidi A, Mohammadpour B, Vafa R, Karandish M. In-school snacking, breakfast consumption, and sleeping patterns of normal and overweight Iranian high school girls: a study in urban and rural areas in Guilan, Iran. Journal of nutrition education and behavior. 2009 Feb 28;41(1):27-31.

29. Krishnan V, Sharmila K. Changing trends in lifestyle behaviour and physical activity on body mass index among medical students. J. Evid. Based Med. Healthc. 2016; 3(31), 1440-1445. DOI: 10.18410/jebmh/2016/328

30. Veltsista A, Laitinen J, Sovio U, Roma E, Järvelin MR, Bakoula C. Relationship between eating behavior, breakfast consumption, and obesity among Finnish and Greek adolescents. Journal of nutrition education and behavior. 2010 Dec 31;42(6):417-21.

31. Faizi N, Khan IM, Amir A, Azmi SA, Ahmad A, Khalique N. Breakfast skipping and proposed effects of breakfast on obesity: A school based study in adolescents in Aligarh, India. Annals of Tropical Medicine and Public Health. 2014 Jan 1;7(1):43.

32. Younes N, Chee CC, Turbelin C, Hanslik T, Passerieux C, Melchior M. Particular difficulties faced by GPs with young adults who will attempt suicide: a cross-sectional study. BMC family practice. 2013 May 24;14(1):68.

33. Shrayyef MZ, Gerich JE. Normal glucose homeostasis. InPrinciples of diabetes mellitus 2010 (pp. 19-35). Springer US.

34. Classification and Diagnosis of Diabetes.Diabetes Care 2015;38(Suppl. 1):S8–S16 | DOI: 10.2337/dc15-S005

35. Woerle HJ, Meyer C, Dostou JM, Gosmanov NR, Islam N, Popa E, Wittlin SD, Welle SL, Gerich JE. Pathways for glucose disposal after meal ingestion in humans. American Journal of Physiology-Endocrinology and Metabolism. 2003 Apr 1;284(4):E716-25.

36. Szablewski L. Glucose homeostasis-mechanism and defects. INTECH Open Access Publisher; 2011.

37. Gerich JE. Control of glycaemia. Bailliere's clinical endocrinology and metabolism. 1993 Jul 31;7(3):551-86.

38. Vander AJ, JH Luciano DS. Humanphysiology: the mechanisms of body function.

39. Unger RH, Eisentraut AM. Entero-insular axis. Archives of Internal Medicine. 1969 Mar 1;123(3):261-6.

40. Gautiera JF, Choukema SP, Girardc J. Physiology of incretins (GIP and GLP-1) and abnormalities in type 2 diabetes. Diabetes & Metabolism. 2008;34:S65-72.

41. Meyer C, Dostou J, Nadkarni V, Gerich J. Effects of physiological hyperinsulinemia on systemic, renal, and hepatic substrate metabolism. American Journal of Physiology-Renal Physiology. 1998 Dec 1;275(6):F915-21.

42. Gromada J, Franklin I, Wollheim CB. α-Cells of the endocrine pancreas: 35 years of research but the enigma remains. Endocrine reviews. 2007 Feb 1;28(1):84-116.

43. Yulan Li,Tohru Nemoto,Satoshi Tobimatsu,Masafumi Saito,Midori Ebata,Hiromi Munakata, Kei Nakajima, Relationship between skipping breakfast and impaired fasting glucose along with cardiovascular and pre-diabetes condition risk factors in apparently healthy subjects Endocrinology Studies 2011; volume 1:e17

44. Michaud C, Musse N, Nicolas JP, Mejean L. Effects of breakfast-size on short-term memory, concentration, mood and blood glucose. Journal of Adolescent Health. 1991 Jan 31;12(1):53-7.

45. Nishiyama M, Muto T, Minakawa T, et al. The combined unhealthy behaviors of breakfast skipping and smoking are associated with the prevalence of diabetes mellitus. Tohoku J Exp Med 2009;218:259-64.

46. Mekary, R.A., Giovannucci, E., Willett, W.C., van Dam, R.M. and Hu, F.B., 2012. Eating patterns and type 2 diabetes risk in men: breakfast omission, eating frequency, and snacking. The American journal of clinical nutrition,*95*(5), pp.1182-1189.

47. Andrew O. Odegaard et al, Breakfast Frequency and Development of Metabolic Risk, Diabetes Care, Volume 36, October 2013

48. Kobayashi F, Ogata H, Omi N, Nagasaka S, Yamaguchi S, Hibi M, Tokuyama K. Effect of breakfast skipping on diurnal variation of energy metabolism and blood glucose. Obesity research & clinical practice. 2014 Jun 30;8(3):e249-57.

49. Uemura M, Yatsuya H, Hilawe EH, Li Y, Wang C, Chiang C, Otsuka R, Toyoshima H, Tamakoshi K, Aoyama A. Breakfast skipping is positively associated with incidence of type 2 diabetes mellitus: evidence from the Aichi Workers' Cohort Study. Journal of epidemiology. 2015 May 5;25(5):351-8

50. Purves D, Augustine GJ, Fitzpatrick D, Katz LC, LaMantia AS, McNamara JO, Williams SM. Neuroscience. Sunderland (MA): Sinauer Associates. doi. 2001;10.

51. Schrank FA. Specification of the cognitive processes involved in performance on the Woodcock–Johnson III (Woodcock–Johnson III Assessment Service Bulletin No. 7). Itasca, IL: Riverside Publishing. 2006.

52. Woodcock RW. New Looks in the Assessment of Cognitive Ability. PEABODY JOURNAL OF EDUCATION. 2002;77(2):6-22.

53. Lo´pez I, de Andraca I, Perales CG, et al. (1993) Breakfast omission and cognitive performance of normal, wasted and stunted schoolchildren. Eur J Clin Nutr 47, 533–542.

54. Gajre NS, Fernandez S, Balakrishna N and Vazir S. (2008) Breakfast eating habit and its influence on attention-concentration, immediate memory and school achievement. Indian Pediatrics 45: 824-828.

55. Tanya Zilberter et al **,** Breakfast and cognition:sixteen effects in nine populations,no single recipe, Frontiers in Human Neuroscience, October 2013|Volume7|Article631 |

56. Jianghong Liu et al,Regular Breakfast Consumption Is Associated With Increased IQ In Kindergarten Children, Early Human Development 89 (2013) 257–262.

57. Vander AJ, JH Luciano DS. Humanphysiology: the mechanisms of body function.

58. Buysee DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.

59. Lentino CV, Purvis DL, Murphy KJ, Deuster PA. Sleep as a component of the performance triad: the importance of sleep in a military population. US Army Medical Department Journal. 2013 Oct 1.

60. Cheng SH, Shih CC, Lee IH, Hou YW, Chen KC, Chen KT, Yang YK, Yang YC. A study on the sleep quality of incoming university students. Psychiatry research. 2012 May 30;197(3):270-4.

61. Sun J, Yi H, Liu Z, Wu Y, Bian J, Wu Y, Eshita Y, Li G, Zhang Q, Yang Y. Factors associated with skipping breakfast among Inner Mongolia Medical students in China. BMC Public Health. 2013 Jan 17;13(1):42.

62. Wang L, Qin P, Zhao Y, Duan S, Zhang Q, Liu Y, Hu Y, Sun J. 9572Prevalence and risk factors of poor sleep quality among Inner Mongolia Medical University students: a cross-sectional survey. Psychiatry Research. 2016 Jul 19.

63. Raabo BE, Terkildsen TC. On the enzymatic determination of blood glucose. Scandinavian journal of clinical and laboratory investigation. 1960 Jan 1;12(4):402-7.

64. World Health Organization. Obesity: preventing and managing the global epidemic. World Health Organization; 2000.

65. Consultation WE. Waist circumference and waist-hip ratio. Report of a WHO Expert Consultation Geneva: World Health Organization. 2008 Dec:8-11.

66. Abu-Hamour B, Al Hmouz H, Mattar J, Muhaidat M. The use of Woodcock-Johnson tests for identifying students with special needs-a comprehensive literature review. Procedia-Social and Behavioral Sciences. 2012 Dec 31;47:665-73.

67. Wong RH, Howe PR, Bryan J, Coates AM, Buckley JD, Berry NM. Chronic effects of a wild green oat extract supplementation on cognitive performance in older adults: a randomized, double-blind, placebo-controlled, crossover trial. Nutrients. 2012 May 3;4(5):331-42.

68. Byrd DA, Touradji PE, Tang MX, Manly JJ. Cancellation test performance in African American, Hispanic, and White elderly. Journal of the International Neuropsychological Society. 2004 May 1;10(03):401-11.

69. Samuels MH, Kolobova I, Smeraglio A, Peters D, Janowsky JS, Schuff KG. The effects of levothyroxine replacement or suppressive therapy on health status, mood, and cognition. The Journal of Clinical Endocrinology & Metabolism. 2014 Jan 13;99(3):843-51.

70. Lezak MD, Howieson DB, Loring DW. Neuropsychological Assessment. New York, NY: Oxford University Press; 1995:371–374

71. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, Cummings JL, Chertkow H. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society. 2005 Apr;53(4):695.

72. Gunstad J, Paul RH, Brickman AM, Cohen RA, Arns M, Roe D, Lawrence JJ, Gordon E. Patterns of Cognitive Performance in Middle-Aged and Older Adults: A

Cluster Analytic Examination. Journal of Geriatric Psychiatry and Neurology. 2006 Jun;19(2).

73. MacLeod CM. The Stroop task in cognitive research. Cognitive methods and their application to clinical research. 2005;9.

74. Stefan MI. Stroop Effect: Team challenge guide.

75. Suleiman M, Hammerman H, Boulos M, Kapeliovich MR, Suleiman A, Agmon Y, Markiewicz W, Aronson D. Fasting glucose is an important independent risk factor for 30-day mortality in patients with acute myocardial infarction. Circulation. 2005 Feb 15;111(6):754-60.

76. Jangam SR, Hayter G, Dunn TC. Impact of glucose measurement processing delays on clinical accuracy and relevance. Journal of diabetes science and technology. 2013 May;7(3):660-8.

77. Yang RJ, Wang EK, Hsieh YS, Chen MY. Irregular breakfast eating and health status among adolescents in Taiwan. BMC Public Health. 2006;6:295.

78.DESHMUKH-TASKAR PR, NICKLAS TA, O'NEIL CE, KEAST DR. The Relationship of Breakfast Skipping and Type of Breakfast Consumption with Nutrient Intake and Weight Status in Children and Adolescents: The National Health and Nutrition Examination Survey 1999-2006. J Am Diet Assoc. 2010;110:869-78.

79. Smith KJ, Gall SL, McNaughton SA, Blizzard L, Dwyer T, Venn AJ: Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study. Am Soc Nutr 2010, 92:1316–1325.

80. Powell CA, Walker SP, Chang SM, Grantham-McGregor SM. Nutrition and education: a randomized trial of the effects of breakfast in rural primary school children. The American journal of clinical nutrition. 1998 Oct 1;68(4):873-9.

81. Szajewska H, Ruszczyński M. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. Critical reviews in food science and nutrition. 2010 Jan 29;50(2):113-9.

82. Pereira MA, Erickson E, McKee P, Schrankler K, Raatz SK, Lytle LA, Pellegrini AD. Breakfast frequency and quality may affect glycemia and appetite in adults and children. The Journal of nutrition. 2011 Jan 1;141(1):163-8.

83. Isaksson H, Rakha A, Andersson R, Fredriksson H, Olsson J, Åman P. Rye kernel breakfast increases satiety in the afternoon-an effect of food structure.

84. Nakade M, Akimitsu O, Wada K, Krejci M, Noji T, Taniwaki N, Takeuchi H, Harada T. Can breakfast tryptophan and vitamin B6 intake and morning exposure to sunlight promote morning-typology in young children aged 2 to 6 years?. Journal of physiological anthropology. 2012 May 22;31(1):11.

85. Harada T, Hirotani M, Maeda M, Nomura H, Takeuchi H. Correlation between breakfast tryptophan content and morningness–eveningness in Japanese infants and students aged 0–15 yrs. Journal of physiological anthropology. 2007;26(2):201-7.

86. Froy O. The relationship between nutrition and circadian rhythms in mammals. Frontiers in neuroendocrinology. 2007 Sep 30;28(2):61-71.

87. Heo JS, Moon HS, Kim MK. A Study on Dietary Habits and Lifestyle of Girls with Precocious Puberty.

88. Bakari AG, Onyemelukwe C, Sani BG, Aliyu S, Hassan SS, Aliyu TM. Relationship between casual blood sugar and body mass index in a suburban northern Nigerian population: a short communication. Nigerian journal of medicine: journal of the National Association of Resident Doctors of Nigeria. 2007;16(1):77-8.

89. Innocent O, ThankGod OO, Sandra EO, Josiah IE. Correlation between body mass index and blood glucose levels among some Nigerian undergraduates. HOAJ Biology. 2013 Mar 26;2(1):4.

90. Dowling HJ, PI-Sunyer FX. Race-Dependent Health Risks of Upper Body Obesity. DIABETES. 1993 Apr;42:537.

91. Varin C, Rancillac A, Geoffroy H, Arthaud S, Fort P, Gallopin T. Glucose induces slow-wave sleep by exciting the sleep-promoting neurons in the ventrolateral preoptic nucleus: a new link between sleep and metabolism. Journal of Neuroscience. 2015 Jul 8;35(27):9900-11.

92. Knutson KL. Impact of sleep and sleep loss on glucose homeostasis and appetite regulation. Sleep Med Clin. 2007 Jun;2(2):187-97.

93. VanHelder T, Symons JD, Radomski MW. Effects of sleep deprivation and exercise on glucose tolerance. Aviation, space, and environmental medicine. 1993 Jun;64(6):487-92.

94. Mortby ME, Janke AL, Anstey KJ, Sachdev PS, Cherbuin N. High ‘‘Normal’’Blood Glucose Is Associated with Decreased Brain Volume and Cognitive.

95. Benton D, Parker PY. Breakfast, blood glucose, and cognition. The American journal of clinical nutrition. 1998 Apr 1;67(4):772S-8S

96. Alhola P. Sleep deprivation: Impact on cognitive performance. Neuropsychiatric Disease and Treatment. 2007;3(5):553-67.

97. Gilbert SP, Weaver CC. Sleep Quality and Academic Performance in University Students: A Wake-Up Call for College Psychologists. Journal of College Student Psychotherapy. 2010;24:295-306.

PROFOMA

Name:

Age:

Sex:

Occupation:

Handedness:

Address:

Father/mother/guardian name:

Phn.no:

HISTORY

1)Diet history

- Do you consume breakfast everyday? : Yes /No
  (within 2 hours of waking up typically before 10AM)
- If yes, what type of food and quantity of food?
- If no, How many times per week do you skip breakfast?

2)Medical history

- History of any medical illness- Diabetes/ Hypertension/ Psychiatric illness/ Colour blindness

3)Drug history

- History of any drug intake:Yes/No
- If yes,mention the drugs

4)Family history of Diabetes mellitus

5)Menstrual history:

- Age at menarche

6)Personal history

- History of smoking
- History of alcoholism
- Bowel and bladder habits

PHYSIOLOGICAL PARAMETERS

1)Height

2)Weight

3) Body mass index=wt/ht^2 (m^2)

4)Waist circumference

5)Hip circumference

6) Waist hip ratio

EXAMINATION

Pulse-

Blood pressure-

GENERAL EXAMINATION

Pallor

Icterus

Cyanosis

Clubbing

Lymphadenopathy

Edema

SYSTEMIC EXAMINATION

CVS-

CNS-

RS-

PA-

Assesment of cognition

- **Mental arithmetic task:**

Time taken for serial subtraction of 7 from 37

- **Response conflict:**

Time take for RCNb (neutral)

Time taken forRCNc(congruent)

Time taken for RCNd (incongruent)

Plasma glucose

- Fasting
- 2hour after 75gm glucose load

Digit span test

	Column 1	Column 2
Forward test	(3) 2−6-5 (4) 1−5−2-3 (5) 2−4−7−6-1 (6) 4-2−1−9−3−7 (7) 3−6−4−8−5−2-9 (8) 7−5−8−2−9−6−1-3 (9) 5−8−6−4−2−7−3−9-1	(3) 2−8-1 (4) 1−9−5-2 (5) 5−2−1−4-3 (6) 8−5−3−1−4-7 (7) 6−8−1−4−7−2-5 (8) 2−8-5-9−7−3−1-4 (9) 4−2−5−8−1−3−9−7-6
Backward test	(2) 2-1 (3) 5−8-4 (4) 4−8−9-1 (5) 6−8−7-2-1 (6) 5−8-1-7−4-6 (7) 8−5−3−6−7−2-9 (8) 1−7−4−3−8−9−5-2	(2) 2-8 (3) 3-2−8 (4) 2−9−4-1 (5) 3−5−9−7-6 (6) 4-3−1−9−2−5 (7) 5−3−2−4−1−6-8 (8) 6−8−4−7−5−3−9-2
Maximal digit number for forward test ( ) + Maximal digit number for backward test ( ) = Total score ( )		

Name_____ Date_____

Sleep Quality Assessment (PSQI)

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. What time have you usually gotten up in the morning? _____
4. A. How many hours of actual sleep did you get at night? _____
   B. How many hours were you in bed? _____

5. During the past month, how often have you had trouble sleeping because you	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
A. Cannot get to sleep within 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)

Scoring

Component 1	#9 Score	C1 _____
Component 2	#2 Score (<15min (0), 16-30min (1), 31-60 min (2), >60min (3)) + #5a Score (if sum is equal 0=0; 1-2=1; 3-4=2; 5-6=3)	C2 _____
Component 3	#4 Score (>7(0), 6-7 (1), 5-6 (2), <5 (3)	C3 _____
Component 4	(total # of hours asleep) / (total # of hours in bed) x 100 >85%=0, 75%-84%=!, 65%-74%=2, <65%=3	C4 _____
Component 5	# sum of scores 5b to 5j (0=0; 1-9=1; 10-18=2; 19-27=3)	C5 _____
Component 6	#6 Score	C6 _____
Component 7	#7 Score + #8 score (0=0; 1-2=1; 3-4=2; 5-6=3)	C7 _____

Add the seven component scores together _____ ***Global PSQI*** _____

Letter cancellation task

B E I F H E H F E G I C H E I C B D A C H F B E D A C D A F C I H C F E B A F E A C F C H B D C F G H E

C A H E F A C D C F E H B F C A D E H A E I E G D E G H B C A G C I E H C I E F H I C D B C G F D E B A

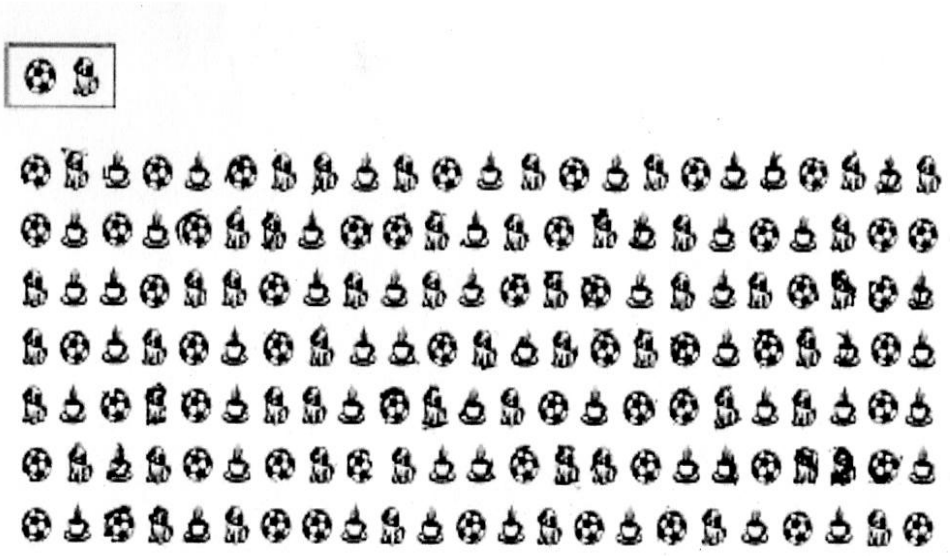
E B C A F C B E H F A E F E G C H G D E H B A E G D A C H E B A E D G C D A F C B I F E A D C B E A C G

C D G A C H E F B C A F E A B F C H D E F C G A C B E D C F A H E H E F D I C H B I E B C A H C D E F B

A C B C G B I E H A C A F C I C A B E G F B E F A E A B G C G F A C D B E B C H F E A D H C A I E F E G

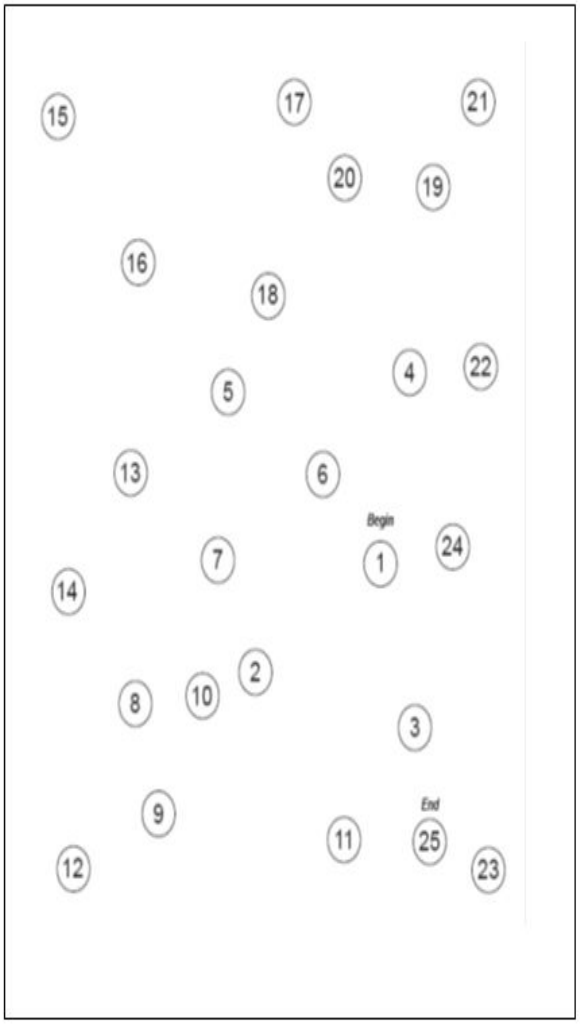
E D H B C A D G E A D F E B E I G A C G E D A C H G E D C A B A E F B C H D A C G B E H C D F E H A I E

Pair cancellation task

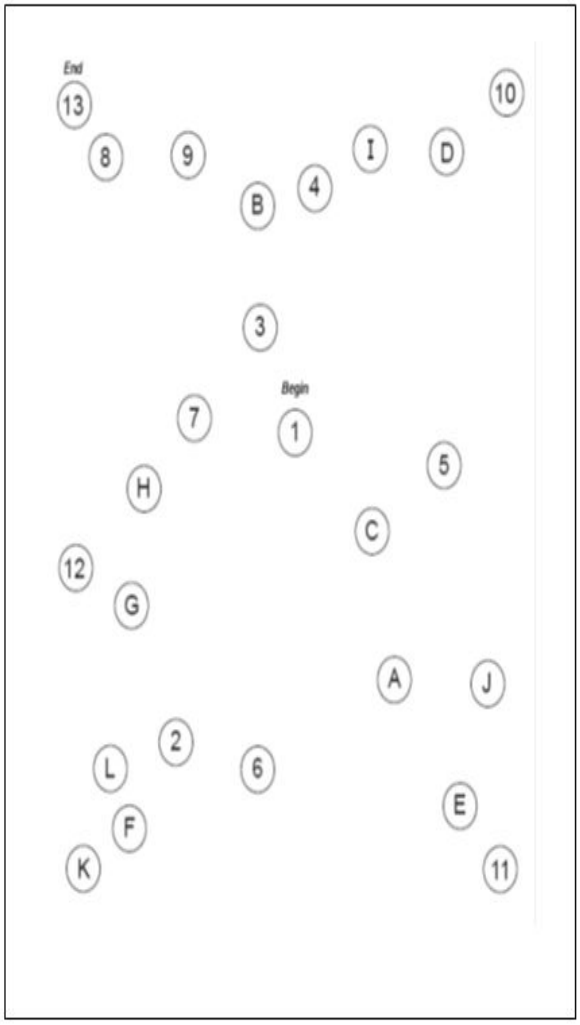


Trail Making test

Část A



Část B



Chennai Medical College Hospital & Research Centre, Irungalur,Trichy-621 105.

CONSENT FORM

You are requested to participate in a study conducted in the Department of Physiology, Chennai Medical College Hospital & Research Centre, Irungalur, Tricy.

Titled -**"EFFECTS OF BREAKFAST OMISSION ON SLEEP QUALITY, COGNITION AND GLUCOSE HOMEOSTASIS AMONG YOUNG ADULTS."**

- Your participation in this study is voluntary.
- Your participation is not a compulsion.
- You have the right to discontinue from the study at any time.
- There will be no cost for participating in this study.
- 3ml of blood will be withdrawn from the antecubital vein on two occasion for study purpose

EXPLANATION OF PROCEDURES:

If you agree to participate in this study, you are expected to give a detailed medical history and we would conduct a clinical examination and withdraw blood for investigation. Data from the study will be used for research purpose only.

ASSURANCE OF CONFIDENTIALITY:

The information concerning your participation in this study will be kept confidential and will be used only for scientific purpose. No one except members of the research team will have access to the results.

We believe that the results of this study will be beneficial for advancements in medical science.

PARTICIPANT CONSENT:

I Mr/Ms _____residing at_____ have read the explanation about this study and provide my consent for participating in this study and for using the results for medical and scientific purposes

Signature of Subject Signature of Researcher

Date:

சென்னை மருத்துவக்கல்லூரி மருத்துவமனை மற்றும் ஆராய்ச்சி மையம்

இருங்களூர், திருச்சிராப்பள்ளி - 621105

சென்னை மருத்துவக்கல்லூரி மருத்துவமனை மற்றும் ஆராய்ச்சி மையத்தின் உடலியல் துறையில் நடத்தப்படும்.

"இளைஞர்களுக்கிடையில் காலை உணவு விடுப்பினால் அறிவாற்றல், தூக்க தரம் மற்றும் குளுகோஸ் அளவு ஆகியவிற்றில் வரும் விளைவுகள்"

இப்பரிசோதனைக்கு சம்மதிப்பது உங்கள் விருப்பத்தைப் பொறுத்தது. கட்டாயம் ஏதும் இல்லை. பரிசோதனையிலிருந்து எந்தநேரமும் விலக தங்களுக்கு முழு உரிமை உண்டு. இச்சோதனைக்கு கட்டணம் கிடையாது. **சோதனையின் போது மூன்று மில்லி ரத்தம் இரண்டு முறை எடுக்கப்படும்**

இந்த ஆய்வின் முடிவுகள் மருத்துவம் மற்றும் ஆராய்ச்சி முன்னேற்றத்திற்கு உதவும் என்று கருதுகின்றோம் இவைகளை வேறு எதற்கும் பயன்படுத்தப்பட மாட்டாது என உறுதியளிக்கிறோம்

ஒப்புதல்

நான் திரு…….…….. முகவரி……...……

நாள் …… அன்று மேற்கண்ட ஆய்வுக்காக தகவல் படிவத்தினை படித்து கேட்டு புரிந்து கொண்டு இந்த ஆராச்சிக்கு என் மனப்புர்வமான சம்மத்தை அளிப்பதோடு இந்த ஆய்வின் முடிவுகளை மருத்துவம் மற்றும் ஆராச்சி நோக்கத்திற்கு பயன்படுத்த ஒப்புதல் அளிக்கிறேன்.

பங்கேற்பாளர் கையொப்பம் ஆய்வாளர் கையொப்பம

KEY TO MASTER CHART

INDEX	Meaning
BMI	Body mass index
WC	Waist circumference
HC	Hip circumference
W:H	Waist hip ratio
PSQI	Pittsburg sleep quality index
PCT	Pair cancellation task
LCT	Letter cancellation task
DST	Digit span task
MAT	Mental arithmetic task
TM-A&B	Trial making task A& B
RCNb	Neutral stroop task
RCNc	Congruent stroop task
RCNd	Incongruent stroop task
FBG	Fasting plasma glucose
OGT	Oral glucose tolerance test

BREAKFAST EATERS

Name	Age	Sex	Menarche	Height	Weight	BMI	WC	HC	WC:HC	PSQI	DST	TM-A	TM-B	LCT	PCT	RCNb	RCNc	RCNd	MAT	FBG	After 75gm
Sowmiya.M	19	F	13	166	64	23.27	86.5	101.5	0.85	6	14	39	64	66	79	72	36	96	16	82	100
Uma	33	F	15	152	49	21.21	82	97	0.84	7	10	56	58	58	83	69	37	101	25	76	110
Sanjana devi	18	F	12	175	108	35.29	125	136	0.9	2	13	25	54	62	82	86	36	88	26	109	207
Janani aishwarya	18	F	12	160	42	16.4	71	83	0.86	7	14	20	42	44	71	41	28	53	19	78	103
Karpagarajee	18	F	11	155	57	23.75	90	100	0.9	2	12	23	72	57	51	60	31	80	19	64	74
Freethi	32	F	14	156	77	31.68	91	121	0.75	4	12	38	100	73	78	59	51	70	14	93	88
Rachel	23	F	13	168	70	24.82	91	110	0.82	3	14	25	51	48	62	54	29	60	19	84	99
Saranya	25	F	13	164	60	22.38	80	96	0.83	3	13	24	48	54	77	51	36	77	26	86	92
Vigneshwari	24	F	13	152	69	29.87	93	110	0.84	4	15	18	49	60	57	51	36	64	12	84	102
Thilaga	26	F	14	154	52	21.94	76	93	0.81	2	12	27	96	60	66	73	25	72	13	94	140
Desika	18	F	11	155	60	25	83	94	0.88	3	12	40	74	65	60	57	31	70	15.7	58	88
Monika	27	F	13	160	65	25.39	94	104	0.9	0	12	40	70	73	61	42	26	57	21	81	130
Kalavathy	26	F	14	157	65	26.4	98	114	0.86	3	14	30	75	73	83	102	26	123	39	102	113
Arivumalar	25	F	15	150	49	21.7	82	88	0.93	1	14	26	76	42	79	52	42	72	17	94	153

Jayashree	18	F	13	156	41	16.87	72	84	0.85	2	14	36	84	48	64	46	37	51	12	60	95
Lavanya	32	F	12	154	69	29.11	94	105	0.89	4	8	22	70	49	50	53	31	73	21	83	106
Anu gayathri	25	F	13	168	67	23.75	82	104	0.78	5	17	35	52	74	70	76	42	84	23	81	136
Lakshmi priya	29	F	14	170	58	20.07	81	94	0.86	2	14	33	45	63	83	58	46	63	14	74	124
Priyanka	18	F	13	163	50	18.79	74.5	86.5	0.86	7	10	25	65	55	70	48	37	57	23	57	102
Roshini	18	F	14	161	78	30	97	120	0.8	6	13	22	56	54	61	64	52	81	12	61	82
Saral	32	F	14	152	46	19.91	81	97	0.83	4	12	23	70	44	65	60	49	103	15	76	112
Hema gowshika	18	F	13	157	58	23.57	92	98	0.94	4	12	29	58	52	60	65	36	79	14	68	127
Dhivya.M.S	25	F	13	159	78	30.9	92	112	0.82	6	15	21	53	57	64	45	43	66	14	77	138
Janani.S	18	F	12	165	60	22.05	89	101	0.88	8	14	29	57	55	62	45	21	49	16	64	85
Petricia	32	F	13	160	70	27.34	92	110	0.83	1	13	31	76	54	64	72	41	69	23	69	110
Laksmi	18	F	14	170	65	22.49	94	109	0.86	6	17	20	50	48	55	31	19	54	18	82	129
Kavi priya	32	F	12	158	60	24.09	73	108	0.67	1	14	52	72	83	70	44	38	59	33	86	145
Siva	23	F	14	147	42	19.4	63	71	0.88	2	11	56	70	47	116	100	59	153	18	92	121
Shanthi	33	F	14	153	45	19.23	70	86	0.81	4	10	36	71	57	72	72	38	66	13	101	120
Gowri	20	F	12	159	74	29.37	90	105	0.86	3	12	25	84	47	75	39	30	68	16	95	112
Vidya	32	F	15	159	65	25.69	92	102	0.9	0	11	36	59	40	90	45	32	59	20	88	99

Sumithra	20	F	15	160	43	16.79	68	80	0.85	2	10	35	75	59	83	74	30	92	26	77	86
Suguna	33	F	13	156	60	24.03	97	101	0.96	2	16	41	84	79	112	80	43	83	25	84	90
Ilavenil	35	F	14	170	62	21.45	86	104	0.84	2	14	24	57	81	95	56	23	59	12	78	103
Benziya	19	F	13	160	60	23.43	92	110	0.83	4	10	42	90	68	81	60	49	116	23	75	65
Ganesh pandiyan	31	M	NA	172	62	21	83	87	0.95	1	15	28	56	60	90	82	63	121	14	88	102
Jibin	18	M	NA	162	60	24.8	78	84	0.9	8	17	31	50	55	76	37	24	76	13	83	113
Hariharan	18	M	NA	190	94.8	26	108	105	0.97	3	16	36	37	45	66	85	25	101	10	66	76
Karthikeyan	20	M	NA	181	86	26.21	95	97	0.97	8	16	31	60	50	65	43	22	58	10	100	113
Manoj	18	M	NA	176	105	33.98	108	112	0.96	6	12	36	66	84	95	52	85	25	11	51	131
Deepan prabhu	22	M	NA	175	90	29.4	100	120	0.83	2	10	32	65	54	59	59	41	90	13	86	92
Sunil kumar	20	M	NA	173	65	21.24	76	87	0.87	8	12	17	75	64	55	58	25	75	21	90	109
Hari	26	M	NA	168	83	29.4	89	102	0.87	1	13	30	72	68	83	60	38	84	10	110	122
Saravanan	33	M	NA	170	110	38	116.84	102	1.15	3	11	51	129	61	69	50	28	60	107	94	114
Jerin daniel	18	M	NA	170	75	25.95	86	90	0.9	7	13	26	50	47	59	48	24	50	19	187	78
Rajajeyakumar	35	M	NA	172	65	22.03	82	96	0.85	2	9	34	59	55	66	79	31	90	16	88	102
Gaushik	18	M	NA	178	68	21.45	82	87	0.94	1	13	25	41	57	54	43	32	64	13	90	109
Venugopal	21	M	NA	168	85	30.14	90	103	0.87	1	10	34	56	43	56	40	37	70	17	74	110

Good roshan	18	M	NA	171	86	29.5	102	110	0.92	9	10	30	108	41	70	70	29	83	28	80	96
Manikandan	18	M	NA	174	66	21.85	80	82	0.98	1	12	34	55	65	55	50	20	67	9	87	93
Karthikeyan	32	M	NA	169	80	27.97	98	103	0.95	1	14	30	50	59	62	61	27	85	20	126	254
Santhosh	28	M	NA	177	78	24.92	87	97	0.87	2	12	15	32	59	71	49	30	84	10	95	107
Naresh	28	M	NA	168	70	24.82	90	110	0.8	3	11	31	45	61	77	46	30	61	12	248	397

BREAKFAST SKIPPERS

Name	Age	Sex	Menarche	Height	Weight	BMI	WC	HC	WC:HC	PSQI	DST	TM-A	TM-B	LCT	PCT	RC Nb	RC Nc	RC Nd	MAT	FBG	After 75gm
Priya	21	F	13	155	38	15.8	61	80	0.76	7	12	56	106	54	105	40	33	110	23	102	142
Thilaga	32	F	14	154	47	19.5	67	88	0.76	2	12	41	70	66	79	35	40	60	21	109	83
Dhanalakshmi	25	F	14	154	50	21.09	70	82	0.85	3	11	27	61	56	70	47	33	75	13	80	97
Reeta	22	F	11	148	45	22.95	70	81	0.86	2	8	56	82	67	103	60	56	120	26	110	148
Athisha	18	F	15	159	74	29.36	87	99	0.87	2	12	30	69	39	54	50	31	80	26	63	89
Ancy	18	F	13	170	64	22.14	81	100	0.81	13	11	59	96	84	75	63	54	97	34	82	108
Karishma	18	F	15	156	40	16.46	62.5	80	0.78	8	13	27	68	45	69	40	24	54	20	65	83
Kavitha	32	F	14	150	57	25.33	71	99	0.71	1	11	47	84	49	60	64	38	75	20	92	96
Reena	18	F	13	156	57	23.45	84	92	0.91	7	13	29	62	64	46	60	40	124	28	61	80
Jashika	18	F	14	161	55	21.2	83	97	0.91	4	16	20	47	47	69	39	22	68	17	73	92
Shalini	18	F	13	142	40	19.9	56	60	0.86	5	12	30	60	51	60	42	29	46	17	71	95
Shruthi	18	F	13	168	76	26.9	105	112	0.93	4	17	17	60	39	45	55	28	72	12	68	88
Keerthana	18	F	15	154	40	16.9	72	86	0.83	8	12	32	43	49	61	44	28	57	19	64	84
Baby	34	F	16	158	41	16.	67	83	0.8	5	13	36	79	57	110	57	38	78	16	74	87

						46															
Akshaya	18	F	11	164	63	23.3	74	88	0.84	3	14	49	84	119	120	62	32	83	13	60	76
Suvalaxmi	18	F	12	167	60	21.58	80	94	0.85	5	14	29	49	48	57	48	35	57	21	68	78
Sudha	30	F	13	157	59	23.94	82	90	0.9	4	10	27	65	70	94	62	38	62	25	103	125
Sophiya	21	F	13	153	45	19.23	71	81	0.87	5	11	33	85	42	75	61	33	82	30	113	92
Lavanya	26	F	14	158	44.5	17.87	73	90	0.81	1	11	34	72	44	59	60	33	72	20	85	90
Amarthya	18	F	13	165	58	21.3	85	93	0.91	3	11	22	47	55	73	47	38	63	14	75	107
Sindhu	25	F	17	160	46	17.96	74	85	0.87	1	12	31	50	39	78	93	28	107	11	78	94
Raihana	21	F	14	156	46	18.9	77	86	0.89	10	11	46	78	43	57	66	35	80	16	71	95
Rupavathi	20	F	15	154	45	18.98	71	79	0.89	4	9	38.5	110	75	98	67	54	79	36	70	97
Mukkamal	28	F	16	153	54	23	88	98	0.89	2	6	37	130	43	69	54	40	80	30	101	121
Shobana	25	F	13	167	68	24.5	90	95	0.95	1	12	17	43	59	65	64	23	75	13	91	140
Prathiba	19	F	12	130	38	22.49	66	77	0.86	2	8	40	90	55	102	74	60	130	20	85	91
Selvi	34	F	15	142	42	20.83	67	82	0.817	1	7	56	107	60	77	62	50	113	26	85	93
Fathima	26	F	13	167	75	26.88	98	116	0.84	2	14	26	50	63	69	50	28	87	20	85	93
Jenifer	22	F	15	155	40	16.64	90	106	0.85	1	8	25	130	43	91	60	52	74	30	79	84
Janaki	28	F	11	154	56	23.6	87	97	0.89	6	10	59	90	70	100	50	40	74	15	96	112

Dhivya	22	F	14	160	57	22.56	74	87	0.85	5	7	37	64	42	71	60	54	120	20	116	149
Nandhini	28	F	15	160	37	14.45	70	78	0.89	8	9	32	57	41	61	47	30	86	24	88	114
Keerthi	22	F	15	165	60	22.05	90	102	0.88	2	8	36	79	59	79	35	56	120	21	107	150
Indhu	25	F	13	160	56	21.87	87	100	0.87	1	7	41	70	58	70	37	30	72	22	92	102
Bhuvana	24	F	14	152	50	21.65	82	99	0.83	4	8	62	82	72	86	72	36	95	21	110	134
Abdul rahim	26	M	NA	175	90	29.4	101	108	0.9	9	10	21	67	60	67	59	27	71	15	71	96
Vigneshwaran	20	M	NA	167	77	27.5	93	96	0.96	6	13	50	62	64	82	59	35	60	12	83	113
Ashwath kumar	25	M	NA	187	74	21.2	99	105	0.94	2	13	17	36	45	62	45	25	79	11	90	110
Miller	32	M	NA	155	55	22.91	90	92	0.97	4	13	38	67	62	81	182	57	166	15	83	98
Agunaveen	18	M	NA	176	68	22	75	85	0.88	14	13	18	68	46	71	54	32	65	12	70	90
Deepan raj	19	M	NA	162	52	19.84	64	78	0.82	5	15	22	37	59	63	58	21	74	11	57	81
Velmurugan	19	M	NA	178	56	17.72	64	76	0.84	6	10	23	88	84	87	64	25	91	14	52	79
Suresh balaji	31	M	NA	172	53	17.91	76	90	0.84	7	11	26	61	74	64	48	32	74	17	70	91
Vignesh.S	19	M	NA	176	70	21.8	84	92	0.91	11	16	34	65	59	79	56	42	62	18	79	104
Raja balaji	21	M	NA	175	74	24.1	92	107	0.86	10	13	37	89	68	81	60	42	67	27	72	110
Vignes	21	M	NA	155	45	18.	67	71.	0.9	7	12	37	79	74	81	52	34	74	20	76	86

I

h ii						75		5												
Vignesh.R	19	M	NA	172	65	22.03	76	78	0.9	12	14	27	41	72	71	48	34	62	28	64	86
Badrinarayanan	19	M	NA	180	72	22.2	80	100	0.8	10	16	20	40	59	61	43	25	56	13	60	83
Rohinth	18	M	NA	169	70	24.5	62	80	0.7	2	12	40	58	89	60	69	28	68	18	57	96
Sudhiram	18	M	NA	162	69	26	90	110	0.81	4	13	18	48	50	63	37	25	56	42	74	91
Selva	23	M	NA	170	50	17.3	74	84	0.88	4	9	30	64	50	70	74	61	90	26	119	127
Karthick	18	M	NA	172	70	23.64	75	86	0.87	7	13	29	55	50	55	67	30	83	9	82	110
Kathiravan	23	M	NA	162	51	19.4	69.66	77.4	0.9	5	9	30	79	39	58	44	30	72	32	80	86